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ECONOMIC

LDP COUNCIL DEBATES U.S. TRADE NEGOTIATIONS

OW100101 Tokyo KYODO in English 0007 GMT 10 Mar 82

[Text] Tokyo, 10 Mar (KYODO)--Members of the Liberal-Democratic Party's Executive Council, the supreme decision-making body of Japan's ruling party, Tuesday complained that the government is not sufficiently exercising its ingenuity in coping with intensified U.S. requests for greater access to the Japanese market.

Tuesday's council session was marked by an outburst of strong opinions over the way the government is going about resolving the problem of Japan's trade friction with the U.S., caused by a lop-sided trade imbalance in favor of this country. The council met as the governments of the two countries opened 2 days of working level talks here on the trade issue, which now threatens to sour the generally cordial relations between the two allies.

Sources close to the party said that the active debate at the meeting reflected growing intra-party concern about the increasing discordance in Japan-U.S. ties. There is apprehension, they added, that if Japan-U.S. talks encounter further rough going, that would give added fuel to demands for a tough Japanese bargaining stance.

The council session came the day after party leaders decided to redouble their efforts to dispel U.S. misunderstandings which they think are at the root of Washington's stiff demands in trade matters.

On Monday, LDP Secretary-General Susumu Nikaido met with David MacDonald, deputy U.S. trade representative, in Tokyo for the trade talks, in an attempt to put Japan's case across to the U.S. side. On the same day, Bunsei Sato, chairman of the LDP's Public Relations Committee, also visited the American Embassy here to make a formal representation against what the party labeled as unfounded allegations in testimony before U.S. congressional hearings.

At Tuesday's Executive Council meeting, Kinji Moriyama, former transport minister, referred to the Nikaido-MacDonald talks and demanded a detailed report. Touching on congressional testimony, about Japan, he demanded that the government present its case in a more convincing and tactful manner. He also said that resolution of the bilateral trade friction could hardly be expected unless Japan dispels misunderstanding which he said stems basically from cultural differences between the two nations.

Yoshimitsu Fujita, former parliamentary vice minister of home affairs, followed with the opinion that the government should give no ground whatever in trade negotiations with the U.S. He charged that the existing civil aviation agreement between Japan and the U.S. runs counter to the spirit of reciprocity and equality.

Fujita also said that the government, in trying to mollify Washington, should never lose sight of the importance of self-sufficiency in food. Agriculture constitutes a vital basis for government, he added. The U.S. is calling for Japan's lifting of residual import curbs on some farm products.

Takashi Hasegawa, former labor minister, referring to Foreign Minister Yoshio Sakurauchi's upcoming trip to the U.S. asked that he lend a full ear to opinions within the ruling party before leaving for Washington.

He also complained the government's effort to acquaint the Americans with Japan's position still leaves much to be desired. He cited the example of the West German Government's buying of U.S. commercial television time to publicize its stand while it negotiated with the U.S. but Ken Harada, former posts and telecommunications minister, called for a calm stance in negotiations with the U.S., saying Japan should not hope always to get its way, in view of favorable treatment the U.S. had accorded it in the postwar years.

CSO: 4120/193

MIYAZAWA ON GOVERNMENT TRADE POLICY

OW121223 Tokyo KYODO in English 1146 GMT 12 Mar 82

[Text] Tokyo, 12 Mar (KYODO)--The Japanese Government will not take any comprehensive measures to liberalize residual import restrictions on agricultural products, Chief Cabinet Secretary Kiichi Miyazawa told a Tokyo press conference Friday. He said the government would not rush to present plans for liberalizing the Japanese market before the eighth summit meeting of the advanced nations in Paris this June.

Miyazawa said the decisions were reached following a report Friday afternoon by Hiromu Fukada, head of the Japanese delegation to the meeting of the Japan-U.S. Trade Subcommittee in Tokyo earlier this week. He said it was unrealistic to prepare a trade package in such a limited time.

Miyazawa termed the subcommittee meetings "effective," and said that on the basis of Fukada's report it seemed sufficient to continue working level discussions between the two countries for the time being. The committee agreed to establish study groups in October to discuss disputed trade items, including beef, oranges and other agricultural products.

Responding to questions about the upcoming Paris summit, Miyazawa said the government would not rush to prepare proposals on the trade issue. "It is not the kind of thing to take up at a Japan-U.S. summit meeting during the Paris talks," Miyazawa said. "We don't want to leave any problems hanging, but it is not realistic to set a time limit and put together a single package."

Meanwhile, a high-ranking Foreign Ministry official said Friday that the United States also appeared pleased with the results of the Trade Subcommittee meeting. Observing that special trade representative Masumi Esaki spoke on his return from the U.S. in February of settling the trade dispute before the Paris summit, the official said "conditions have changed since then."

CSO: 4120/193

LDP'S NIKAIDO ON TRADE DISPUTE WITH U.S.

OW121151 Tokyo KYODO in English 1048 GMT 12 Mar 82

[Text] Tokyo, 12 Mar (KYODO)--Liberal-Democratic Party Secretary General Susumu Nikaido said Friday that Japan-U.S. trade problems eventually will have to be settled at a summit conference between Prime Minister Zenko Suzuki and U.S. President Ronald Reagan.

In a speech at a Tokyo hotel, Nikaido said he believed that the trade friction was no longer an economic but a political problem. He also asserted that it was important for Japan to propose a concrete plan to deal with the worldwide economic recession at the summit conference of seven industrially advanced nations in Paris in June. This view suggests that Japan should draw up a plan to open up its market further to foreign products prior to the Paris summit.

He did not indicate whether a meeting between Suzuki and Reagan should precede or follow the economic summit.

Nikaido then proposed a new Tokyo round of multilateral trade negotiations by saying, "Trade friction is a multilateral problem rather than a bilateral issue." Settlement of this problem should not be taken up at an administrative level, he said.

Nikaido also expressed displeasure over a report that some 50 LDP Dietmen had signed a document calling for a revision of the Japan-U.S. security treaty. LDP Dietmen should act cautiously at a time when Japan-U.S. relations are far from smooth, he stressed.

CSO: 4120/193

FOREIGN TRADE FIGURES FOR FEBRUARY UP

OW121017 Tokyo KYODO in English 0903 GMT 12 Mar 82

[Text] Tokyo, 12 Mar (KYODO)--Japan's foreign trade resulted in a $334 million surplus on a customs-cleared basis in February, the Finance Ministry announced Friday in a preliminary report. This compared with a $1,854 million deficit in January and a $296 million surplus a year ago. February exports, at $11,656 million worth, were off 3.7 percent--the first year-to-year fall in 6 years. Imports declined 4.1 percent to $11,322 million.

Japan's trade surplus with the United States rose to $1,157 million from January's $611 million and that with the European Community (EC) to $837 million from 752 million.

On a quantitative basis, February exports were up by a 0.3 percent over a year ago after a 12.8 percent rise in January. Imports rose 2.9 percent after a 6.1 percent gain the previous month.

Shipments of motor vehicles fell 10.2 percent to 491,962 units, valued at $2,144 million. Cars accounted for 350,499 units, off 15.2 percent from a year ago.

Exports of ship bottoms rose 36.1 percent to 652,772 gross tons, worth $534 million, up 35 percent.

Shipments of video tape recorders soared 79.7 percent to 757,000 units. Those to the common market doubled to 328,000 units, and those to the United States came to 209,000.

Crude oil imports, which normally account for 40 percent of the total imports, fell 1.1 percent to 19.97 million kiloliters (some 125 million barrels). They were valued at $4,501 million, off 3.7 percent.

Influenced by the port workers' strike in Australia, coal imports fell 21.8 percent to 5.1 million tons.

After seasonal adjustments, February exports were off 12.2 percent at $12,133 million worth, while imports declined 5.8 percent to $11,843 million. The resultant $290 million surplus compared with a $1,249 million surplus in January.

CSO: 4120/193

U.S. ALASKAN CRUDE EXPORT COULD EASE TRADE ISSUE

OW181127 Tokyo KYODO in English 1054 GMT 18 Mar 82

[Text] Tokyo, 18 Mar (KYODO)--Foreign Minister Yoshio Sakurauchi said in the Diet Thursday that "dramatic measures" should be taken not only by Japan but also by the United States to resolve the current trade disputes between the two countries. The foreign minister was apparently reacting to the recent repeated calls from the United States that Japan should come up with major new measures to slice its trade surpluses with the United States.

Answering questions at a House of Representatives Committee session, the foreign minister said one half of the trade problem would be solved if the United States started exporting Alaskan crude oil to Japan. While Japan makes efforts to open its market wider for foreign goods, the United States should also take such positive measures as removing its existing ban on the export of Alaskan crude, he said. He said he is ready to request the removal of the ban when he visits Washington starting Saturday.

Touching on the "reciprocity" bills now before the U.S. Congress which call for retaliatory action to Japan's trade barriers, Sakurauchi said "one should not be optimistic that the bills will be stopped." If made into law, the bills will lead to shrinking of trade, he said.

He added, however, that it would be "diplomatically difficult" to take a joint action with the European Community against the U.S. congressional move.

CSO: 4120/196

ECONOMIC

CANADA'S LUMLEY REQUESTS CAR SHIPMENTS BE CURBED

OW170503 Tokyo KYODO in English 0451 GMT 17 Mar 82

[Text] Tokyo, 17 Mar (KYODO)--Canadian International Trade Minister Edward C. Lumley Wednesday asked Japan to continue its voluntary restraints on auto shipments to Canada in fiscal 1982 starting in April. He made the request in a meeting with Shintaro Abe, Japanese international trade and industry minister, a Miti spokesman said.

The spokesman said Abe was noncommittal, suggesting that the two governments make a fundamental review of the car trade problems, including whether to continue the present self-restraint formula. The matter will be discussed at working-level talks, the spokesman added.

Under the present formula, Miti gives an annual "forecast" of a prospective level of Japanese car exports to Canada by way of voluntary curbs on shipments. That level for fiscal 1981, ending 31 March, was the actual 1980 exports plus 10 percent. Miti said Japanese shipments in the first 11 months of fiscal 1981 totaled 162,661 units.

The two ministers shared concerns over the reciprocity trade legislation now before the U.S. Congress, the Miti spokesman said. They also agreed to sign a joint export insurance agreement. The agreement to be concluded between Miti and the Export Development Corporation (EDC) of Canada will make it easier and less risky for Japanese firms to form consortiums with Canadian companies to win orders in third countries.

Without such an agreement, a subcontractor in joint undertakings cannot demand payment directly to a buyer in case of a default. The arrangement enables insurance agencies to cover risks not only for main contractor but also subcontractor.

Abe told Lumley that Miti will send a 40-member mission to Canada to study investment circumstances there.

Shingo Moriyama, former head of the National Resources and Energy Agency, will lead the group, which leaves 27 March for a 16-day visit.

CSO: 4120/196

BRIEFS

[illegible] AGRICULTURAL IMPORTS URGED--Nagoya, 12 Mar (KYODO)--Yoshihiro Inayama, president of the Federation of Economic Organizations (Keidanren), Friday urged the government to quickly liberalize agricultural imports in order to settle trade problems with the United States. At a press conference at a hotel in Nagoya, where he will hold talks with local businessmen, Inayama said, "For the U.S., trade friction is a problem of national prestige rather than an economic issue connected with a huge trade deficit." He said it would become impossible for Japan to prevent reciprocity legislation being passed by the U.S. Congress if Japan refused to open up its market to U.S. farm products. The present situation in the United States does not allow Japan-U.S. trade friction to be left unresolved, he stressed. He said Japan had no alternative but to increase imports from the United States to keep it from establishing restrictions against Japanese exports. On the tax reduction issue, Inayama said he would oppose any tax cut unless the government slashed its expenditures further. [Text] [OW121237 Tokyo KYODO in English 1226 GMT 12 Mar 82]

COOPERATION WITH EC--Brussels, 16 Mar (KYODO)--A visiting Japanese trade delegation and European Community Comission leaders have agreed that Japan and the commission must work closely to curb mounting protectionism in European nations. The agreement was reached during 2 days of talks held here between the delegation of the Japanese ruling Liberal-Democratic Party and EC Commission leaders, including President Gaston Thorn and Vice President Wilhelm Haferkamp. Summarizing the outcome of the talks, Masumi Esaki, leader of the Japanese mission, and Haferkamp told a joint press conference Tuesday evening that protectionism has been mounting in European countries amid a severe slump of their economies. They said they agreed Japan and the EC Commission must do everything to curb such protectionist tendencies. Haferkamp said a series of market liberalization measures taken recently by the Japanese Government are not enough to quell European dissatisfaction with the current state of trade between Japan and the European Common Market countries. He said the EC Commission will closely watch what efforts Japan will make in this direction in the coming 2 to 3 years. The Japanese mission left here for London Wednesday evening for talks with British Government leaders. [Text] [OW170153 Tokyo KYODO in English 0115 GMT 17 Mar 82]

SOLVING FRICTION WITH U.S.--Tokyo, 19 Mar (KYODO)--It will be necessary to hammer out a comprehensive pacakge to solve the current Japan-U.S. trade friction prior to the summit meeting scheduled in Paris for June, Shintaro Abe, minister of international trade and industry said Friday. Abe told a press conference after the Friday cabinet meeting that trade friction may become intensified unless a package proposal is made before the summit meeting. Chief Cabinet Secretary Kiichi Miyazawa and Foreign Minister Yoshio Sakurauchi also shared the view that comprehensive measures would be necessary before the summit, according to Abe. [Text] [OW190321 Tokyo KYODO in English 0306 GMT 19 Mar 82]

TRADE TALKS WITH FRANCE--Tokyo, 15 Mar (KYODO)--France and Japan began 2 days of talks Monday to promote trade by correcting a trade imbalance currently in favor of Japan, Japanese officials said. For its part, the officials said, Japan will ask France to remove import restrictions for Japanese vehicles and other products. French envoy to Tokyo Xavier Daufresne de La Chevalerie stressed in an opening speech Japan must take more comprehensive steps to rectify the trade imbalance which came to $1.05 billion in Japan's favor last year. The French have insisted in previous trade consultations the Japanese Government should reduce tariffs and liquor taxes on brandy and wine and increase imports of processed cheese and leather shoes. The meeting coincided with the start of French Foreign Trade Minister Michel Jobert's 5-day visit to Japan to improve economic relations. Jobert has said he hopes to iron out major differences over trade issues to enable President Francois Mitterrand to devote more time to other issues during his official visit to Japan next month. [Text] [OW150351 Tokyo KYODO in English 0330 GMT 15 Mar 82]

CSO: 4120/193

FY-82 SCIENCE, TECHNOLOGY BUDGET DRAFT REPORTED

Tokyo KAGAKU SHIMBUN in Japanese 22 Jan 82 p 1

[Text] The total FY-82 budget for the Science and Technology Agency is 386,088,000,000 yen, a 4.8-percent increase over FY-81. Of this, the general account includes 319,200,050,000 yen, a 3.4-percent increase over the previous year, and the Special Account for Electric Power Source Development Promotion Policy is 66,838,000,000 yen, a 12.2-percent increase. As for the characteristics of the FY-82 budget draft, first of all, approximately 2 billion yen is appropriated for "promotion of creative science and technology by means of a rheological research system" that is to be conducted on a full scale by the Research Development Corporation of Japan. The budget totals for both nuclear power development and space development have increased, but only by 1 percent. On the other hand, spending for ocean development and disaster prevention science and technology have decreased by a large margin. The budget for preparation of the International Science and Technology Exposition is approximately seven times that of the previous year. The opening of the exposition is only 4 years away now. Unless we start to boil down exhibition-related projects and construction of pavilions now, the organizers say that they cannot make preparations in time. That is the reason for the large increase in the budget. In addition, the budget for promotion of international cooperation is of some concern. Over 10 billion yen is appropriated for cooperation with advanced countries. On the other hand, the budget for cooperation with developing countries is only 75 million yen. With this figure, can we proudly call ourselves "one of the advanced nations in science and technology?"

A Large Decrease for Ocean Development and Disaster Prevention

Expansion and Improvement of Science and Technology Promotion Adjustment Expenses: 6 billion yen, a 79.1-percent increase over the previous year.

Promotion of Creative Science and Technology by Means of a Rheological Research System: 1.98 billion yen.

Promotion of Nuclear Power Development and Use: 176.2 billion yen. (1) The budget for administration of nuclear power safety regulations and environmental safety measures is 2,131,000,000 yen. (2) The budget for the Power Reactor and Nuclear Fuel Development Corporation is 72,675,000,000 yen. Of this, 48,995,000,000 yen is for development of power reactors (21.63 billion yen for development of a fast breeder reactor and 2,185,000,000 yen for development of a new type converter), and 3.98 billion yen is for development of uranium enrichment technology. (3) The budget for the Japan Atomic Energy Research Institute is 84,601,000,000 yen. Of this, 41,236,000,000 yen is for research and development of nuclear fusion (34,569,000,000 yen for construction of the JT-60 and 3,042,000,000 yen for Japan-U.S. nuclear fusion cooperation), and 5,455,000,000 yen is for research and development of a multipurpose high-temperature gas reactor. (4) The budget for the Japan Nuclear Ship Development Agency is 7,197,000,000 yen. (5) The budget for the National Institute of Radiological Sciences is 5,851,000,000 yen. Of this, 2,091,000,000 yen is for the construction of an internal exposure experiment house, and 314 million yen is for research on the influence of low-level radiation. (6) The budget for the research and testing projects of national research and testing institutions is 1,764,000,000 yen. (7) The budget for nuclear power research of the Institute of Physcial and Chemical Research is 1,221,000,000 yen. Of this, 614 million yen is for construction of a heavy ion accelerator.

Promotion of Space Development: 87,666,000,000 yen, a 1.2-percent increase. (1) The budget for the National Space Development Agency is 86,376,000,000 yen. Of this, 20,475,000,000 yen is for research on development of the H-1 rocket; 8,233,000,000 yen is for development of a second communications satellite; 5.09 billion yen is for development of a second broadcast satellite; 5,064,000,000 yen is for development of a third geostationary meteorological satellite; 7,288,000,000 yen is for development of the first marine observation satellite; 20 million yen is for research on next generation communications satellite technology; 669 million yen is for manufacture of prototypes and testing of earth observation equipment such as a synthetic aperture radar; and 3,311,000,000 yen is for the reception and processing of earth observation information. (2) The budget for the National Aerospace Laboratory's research on space development is 758 million yen. Of this, 95 million yen is for research on liquid oxygen liquid hydrogen rocket engine elements, and 62 million yen is for research on basic technology for satellites.

1.1 Billion Yen for Earthquake Prediction

Promotion of Ocean Development: 5,585,000,000 yen, a large decrease of 20.4 percent. (1) The budget for the Center for Marine Science Technology is 5,358,000,000 yen. Of this, 1,466,000,000 yen is for research on submarine work technology and construction of an underwater work experiment ship;

1,431,000,000 yen is for investigation and research by deep sea submarine investigation; 35 million yen is for research and development of ocean energy; and 107 million yen is for research and development of sea area control technology and a new marine observation system. (2) The budget for other ocean development projects is 227 million yen. Of this, 120 million yen is for research and study of the development and use of the Japan Current, and 88 million yen is for research on the development of oceanic remote probing technology.

Promotion of Disaster Prevention Science and Technology: 2,317,000,000 yen, a 9-percent decrease. Of this 1,166,000,000 yen is the budget related to earthquake prediction. (1) The budget for the National Research Center for Disaster Prevention is 2.25 billion yen. Of this, 1,105,000,000 yen is for the study of earthquake prediction; 137 million yen is for study of earthquake disaster measures; and 65 million yen is for study of snow disaster measures. (2) The budget for other studies is 67 million yen.

Promotion of Important Comprehensive Research: 25,138,000,000 yen, a 4.6-percent increase. (1) The budget for promotion of life sciences is 1,098,000,000 yen. Of this, 1,091,000,000 yen is for promotion of life sciences at the Institute of Physical and Chemical Research, which includes 538 million yen for construction of recombinant DNA research facilities. (2) The budget for research and development of aeronautical technology at the National Aerospace Laboratory is 8,952,000,000 yen. Of this, 5,641,000,000 yen is for research and development of a fanjet STOL experimental aircraft. (3) The budget for the Institute of Physical and Chemical Research (excepting the nuclear power and life sciences divisions) is 6.92 billion yen. Of this, 335 million yen is for research on laser science technology. (4) The budget for promotion of research and development of materials technologies such as materials related to extremity science and technology is 5,672,000,000 yen. Of this, 3,925,000,000 yen is for materials research of the National Research Institute for Metals, and 1,747,000,000 yen is for materials research of the National Institute of Research in Inorganic Materials. (5) The budget for promotion of comprehensive use of resources policy is 379 million yen. Of this, 262 million yen is for the National Institute of Resources; 81 million yen is for field surveys of regional energy comprehensive use; and 10 million yen is for basic research on effective use of protein. (6) The budget for commercialization of new technologies and transfer of technologies is 2,117,000,000 yen. Of this 2,091,000,000 yen is for the Research Development Corporation of Japan; 15 million yen is for subsidization of the commercialization and testing expenses of inventions; and 11 million yen is for selection of remarkable inventions.

A Sevenfold Increase for the Science and Technology Exposition

Expansion and Improvement of the Base for Science and Technology Promotion: [illegible],045,000,000 yen, a 2.2-percent increase. (1) The budget for strengthening of bases for research and development such as formulation of the Basic Plan for Science and Technology is 425 million yen. Of this, 63 million yen is for compilation of the Basic Plan for Science and Technology, and 362 million yen is for domestic and overseas studies of government researchers. (2) The budget for promotion of research exchange activities at the Tsukuba Research Campus City is 60 million yen. (3) The budget for promotion of scientific and technical information distribution is 4,323,000,000 yen. Of this, 4,307,000,000 yen is for the Japan Information Center of Science and Technology. (4) The budget for promotion of information and education relating to science and technology is 237 million yen.

Promotion of Preparations for the International Science and Technology Exposition: 4,752,000,000 yen, a 6.6-percent increase. Of this, 1,718,000,000 yen is for promotion of government-exhibition-related projects, and 3,004,000,000 yen is for aid to projects of the International Science and Technology Exposition Association.

Promotion of International Cooperation: 11,133,000,000 yen, an 18-percent increase. Of this, 10,855,000,000 yen is for promotion of cooperation with advanced nations; 75 million yen is for promotion of cooperation with developing countries; and 203 million yen is for promotion of cooperation with international organizations.

9896
CSO: 4106/63

SCIENCE AND TECHNOLOGY

MINISTRY OF EDUCATION'S 1982 SCIENCE BUDGET OUTLINED

Tokyo KAGAKU SHIMBUN in Japanese 29 Jan 82 p 1

> [Text] On 20 January the Ministry of Education released an outline of its 1982 budget. Among the major items related to Science and International Bureaus, "expansion of grants for expenditure on scientific research" is to receive 38 billion yen (a 6.1-percent increase over last year); with the "expansion of important fundamental research," there will be forceful development of energy-related science--1) development within universities of fusion research, and 2) research on new sources of energy and the conservation of energy--the development of accelerator science ("Tristan" planning, and completion and operation of the Radiation Beam Test Facility), the development of space science, the development of means of predicting earthquakes and volcanic eruptions, the development of life science, the development of materials science, and so on.

"Funding for grants for expenditure on scientific research," in view of its scientific and social importance and because of the new item of "special development research," has been increased 2.2 billion yen (6.1 percent) over last year, to 38 billion yen.

--Special research on cancer: 2.07 billion yen (same as last year).
--Special research on natural disasters: 530 million yen (same).
--Special research on environmental science: 950 million yen (same).
--Special research on energy: 2.1 billion yen (same)--1) energy 1.3 billion yen, and 2) fusion, 800 million yen.
--Designated research: 4.77 billion yen (same).
--Combined research A: 2.53 billion yen (same).
--Combined research B: 180 million yen (same).
--General research A: 3.91 billion yen (same).
--General research B: 5.46 billion yen (same).
--General research C: 4.52 billion yen (same).
--Special development research (new item) 1 billion yen. This is to support for up to 3 years superior research of Nobel Prize quality at 100 million yen per year per case. Such research has been selected since 1979--2 cases in that year, 4 in 1980 and 10 in 1981--but starting in 1982 this will be recognized formally as a budget item, "special development research."

--Testing research: 2.834 billion yen (last year 2.53 billion yen) for further development through joint research with private industry scientists when there is a social demand for the results of research in universities and the like. This is an increase over last year of 12 percent.

--Encouragement of research A: 2.98 billion yen (last year 2.23 billion yen) for the training of promising young researchers. This is an increase over last year of 33.6 percent.

--Encouragement of research B: 990 million yen (same as last year).

--Overseas scientific investigation: 1.056 billion yen (last year 910 million yen) in response to the increasing necessity of scientific research activity outside the country due to the recent internationalization of science. This is an increase of 16 percent over last year.

Seven Hundred Million for Heliotron

As for "fusion research," the inauguration of fusion research within universities is to be continued and developed.

--The Tohoku University Research Institute for Iron, Steel, and Other Metals "Fusion Superconducting Materials Experimental Facility": 1.017 billion yen (last year 487 million yen).

--The Tsukuba University Plasma Research Center "Fusion Mirror Experimental Facility--Construction of Gamma 10": 2.154 billion yen (last year 2.075 billion yen), to be completed in 1983.

--Nagoya University Plasma Physics Research Institute "Fusion Reaction Plasma Preliminary Experimental Facility": 1.31 billion yen (last year 1.172 billion yen), to be completed in 1983.

--Tokyo University Heliotron Fusion Research Center "Heliotron E Facility": 768 million yen.

--Osaka University Laser Fusion Research Center "Gekko 12 Laser Facility": 2.74 billion yen (last year 2.922 billion yen), to be completed in 1984.

"New energy sources and conservation of energy research" is being carried out at established facilities such as : 1) the Ocean Heat Energy Conversion Experimental Institute (Saga University), the Electrical Energy Conversion Experimental Institute (Kanazawa University) and the like; and 2) the Closed Cycle MHD Generator Experimental Facility (Tokyo Institute of Technology), the Thorium-type Radiation Data Measuring Facility (Tohoku University) and the like.

--Tokyo Institute of Technology Joint Physics and Engineering "Closed Cycle MHD Generator Experimental Facility": 290 million yen (last year 325 million yen), to be completed in 1983.

--Tokyo University Atomic Energy Joint Research Center "Heavy Irradiation Damage Research Facility": 320 million yen (last year 240 million yen), to be completed in 1983.

"Development of accelerator science" consists of development of the High Energy Physics Institute's second accelerator plan, the "Tristan" plan, and completion and beginning of operation of the same institute's "Radiation Beam Experimental Facility."

--The "Radiation Beam Experimental Facility": 957 million yen (last year 2.875 billion yen).

--The "Tristan" design: 5.358 billion yen (last year 4.99 billion yen), to be completed in 1985.

[illegible] Search for Black Holes

"Development of space science" is comprised of: 1) the launching of a scientific satellite and observatory rocket (Space Science Institute), and 2) the construction of a large radio telescope (Tokyo University Nobeyama Radio Observatory).

--Tokyo University Tokyo Astronomical Observatory "Nobeyama Radio Observatory": [illegible] million yen 1.465 billion yen last year), to be completed in 1982.
--Launch of eighth scientific satellite = launch of M-3 S-3 rocket to perform astronomical observations, including a search for black holes in the galaxy.

"Marine science" consists of continuation of the international project for excavation in deep ocean waters and construction of a research ship (Tokyo University Ocean Research Institute).

--International Deep Ocean Project (IPOD): 1.248 billion yen (last year 1.124 billion yen).
--Tokyo University Ocean Research Institute "Construction of Research Ship 'Tansei-maru,' 406 tons": 877 million yen (last year 780 million yen), to be completed in 1983.

"Development of methods for prediction of earthquakes and volcanic eruptions" consists of development of: 1) the fourth earthquake prediction project, and 2) the second volcanic eruption prediction project. Taken together, the budget is 2.228 billion yen (last year 2.214 billion yen).

Establishment of the Life Preservation Medical Institute

"Development of life science" consists of establishment of: 1) the Life Preservation Medical Institute (Kyushu University), and 2) the Cell Engineering Center (Osaka University).

--Establishment of the Life Preservation Medical Institute (conversion of the Kyushu University Hot Springs Therapeutics Institute).

"Antarctic Observation Projects" consist of: 1) carrying out the 24th observation, and 2) construction of a new icebreaker (continuation).

--[illegible] of the 24th Antarctic observation: 2.617 billion yen (last year [illegible] billion yen).
--Construction of the new icebreaker "Shirase": 8.098 billion yen (last year [illegible] billion yen).

"Development of scientific exchanges" consists of preliminary studies for the establishment of a University-Scientific Meeting Center (temporary name).

--[illegible] University-Scientific Meeting Center (temproary name) preliminary study: [illegible] million yen (last year 16.5 million yen)
--[illegible] of the establishment of a scientific information center: 32.9 million yen (last year 26.5 million yen).

"Expansion of the activities of the special legal entity The Japanese Society for the Advancement of Science" confers an overall budget of 3.2 billion yen (last year 2.988 billion yen).

--Development of the social cooperation of science (new item) consists of the establishment of a "General Research Coordination Council" (temporary name) and other matters.
--Sending of young researchers overseas (new item), 10 individuals for 2 years.
--Exchange of researchers.
--Exchanges with developing countries: 412 million yen (last year 400 million yen), consisting of grants to doctoral degree candidates (number of degree candidates increased from 10 to 16, dispatch of research leaders increased from 5 to 8).
--Scientific and technical cooperation between Japan and the United States: 2,429,500,000 yen (last year 2,279,700,000 yen).
--Scientific cooperation with China: 158 million yen (last year 166.1 million yen). Also, exchange with the China Scientific and Technical University (Ho-fei) (new item).

9898
CSO: 4106/56

SCIENCE AND TECHNOLOGY

PETROCHEMICAL INDUSTRY PUSHES FOR EASING OF RESTRICTIONS ON NAPHTHA IMPORTS

Tokyo JAPAN PETROLEUM & ENERGY WEEKLY in English Vol 17, No 7, 15 Feb 82
pp 1-7

[Text]

The controversy between the petrochemical and petroleum refining industries over the question of naphtha imports has recently been heating up. The Basic Industries Bureau (under whose jurisdiction the petrochemical industry lies) and the Natural Resources & Energy Agency (under whose jurisdiction the refining industry lies) -- both within the Ministry of International Trade and Industry -- are taking opposite sides over the issue.

At present, under the Petroleum Enterprise Law (Law No.128 of 1962), naphtha imports are conducted solely through the oil companies, and import quantities are regulated according to guidelines of the Natural Resources & Energy Agency. However, due to their rapidly diminishing international competitiveness, the petrochemical industry is currently pressing the MITI minister for permission to import lower-cost naphtha directly, rather than be forced to purchase more costly domestic supplies from oil companies.

Japanese petrochemical industry is currently suffering from: i) the rise in price of domestic naphtha resulting from sharp increases in crude oil [illegible] [illegible] stiff competition from U.S. and Canadian petrochemical products due [illegible] lower-cost petrochemical feedstocks, and iii) depressed demand for petrochemicals in the domestic market, coupled with the export markets lost in [illegible] Asian countries as a result of the export offensive from the [illegible] petrochemical industries. Under the circumstances, the petrochemical industry has been seeking the right to directly import lower-cost naphtha in order to reduce costs and thus to increase domestic and international price competitiveness. The oil industry, meanwhile, has been profiting from naphtha imports on behalf of petrochemical companies, and is intent on continuing to supply naphtha to the petrochemical companies to compensate for its own distressed state. The outcome of the current debate will depend not only on which industry requires government assistance the most, but also on the intramural struggles within MITI -- i.e., the Basic Industries Bureau vs the Natural Resources and Energy Agency.

Since August 1980, the price of imported naphtha, on the average, has been below that of domestically produced naphtha. As a result, imports have been rising and naphtha production at local refineries has been declining to a minimum feasible in terms of yield on crude. In 1977, the naphtha yield on crude was 10.2 percent. By September 1981, it had dropped to 8.6 percent, and by November 1981 to 7.5 percent. The naphtha import ratio, meanwhile, rose from 29.6 percent for the year ended March 1981, to 35.4 percent for the period between January and November 1981, and as of November 1981 the naphtha import ratio was 44.5 percent.

The Petrochemical Industry's Position

The petrochemical industry believes that, due to the continuing lower cost of imported naphtha, it should be allowed to import naphtha directly in order to strengthen the price competitiveness of Japanese petrochemicals against those from the U.S. and Canada. The industry would also like to have stockpiling requirements reduced, as they lead to increased storage and in turn, product costs. Also, the industry is asking that the Petroleum Tax* be reduced or removed on domestically produced naphtha used for petrochemical feedstock since raw materials for petrochemical products are tax exempt in Europe and the U.S., which gives them an even greater advantage over Japanese products.

In an attempt to establish independence in securing the naphtha feedstock, seven petrochemical companies jointly established a company called Petrochemical Feedstock Importing Co., Ltd. (PEFIC) on September 8, 1978, with each company holding an equal equity share of the capital (presently paid in at ¥14 million). The seven companies are: Mitsubishi Chemical Industries, Mitsubishi Petrochemical, Mitsui Petrochemical Industries, Osaka Petrochemical, Sanyo Petrochemical, Showa Denko, and Sumitomo Chemical. These ethylene producing companies differ from other ethylene producers such as Nippon Petro-

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*) The "Petroleum Tax" on crude oil and imported products was instituted effective from June 1, 1978, with the purpose of securing a new source of treasury revenue to cope with the then worsening shortfall of national revenues resulting from the protracted business recession. A portion of the Petroleum Tax revenues is now used to fund Japan's energy projects such as the oil stockpile expansion and the promotion of oil & gas exploration and development. The tax rate is 3.5 percent on an ad valorem basis of the c.i.f. cost plus import duty of the imported crude or of the wellhead price of the locally produced crude oil. Based on the current c.i.f. crude oil import cost ($36.0/bbl) and the import duty (¥640/kl) and the exchange rate of 240 yen to the U.S. dollar, the Petroleum Tax on crude oil is estimated at ¥1,920/kl ($1.27/bbl). This tax rate therefore applies to all domestically refined products including naphtha. For imported products, "adjustment factors" ranging from 40 to 80 percent are applied to reduce the amount calculated from the foregoing formula -- i.e., 3.5 percent of the (c.i.f. cost plus import duty). Exceptionally, imported naphtha for manufacturing petrochemical products and ammonia are exempted from the Petroleum Tax.

[illegible] Tonen Petrochemical, Idemitsu Petrochemical, and Maruzen Petrochemical, in that the latter companies are wholly owned subsidiaries of refiners and hence are in a better position to obtain naphtha under favorable conditions.

After its establishment, PEFIC submitted an application to MITI for registration as a petroleum importer, but so far the Natural Resources & Energy Agency has been refusing approval. Under the provision of Article 12 of the Petroleum Enterprise Law, anyone who wishes to engage in petroleum import business must be registered with the Ministry of International Trade and Industry.

The Natural Resources & Energy Agency's Position

The agency's position is based on a general policy of considering the problems of the petrochemical industry from the standpoint of Japan's overall energy policy. In order to maintain secure and stable energy supplies and to coordinate procurement of crude oil and products, including naphtha, the agency feels that it is still necessary to limit the number of companies which import petroleum in order to maintain a balance between supply and demand.

The agency also feels that if petrochemical companies were allowed to import naphtha, Japan's petroleum refiners would have to compete with these imports on a price basis. During periods when imported naphtha prices are lower than domestic prices, such as at present, the refiners would have to adjust the prices of other oil products in order to be competitive with the imported naphtha, which would result in confusion in oil product pricing in general.

The agency feels that enough preferential treatment has already been given to the petrochemical industry. Under the present Petroleum Stockpile Law, there is a 90-day stockpiling requirement for the crude oil to be used for naphtha production, while there is only a 70-day stockpiling requirement for imported naphtha. In addition, the imported naphtha is exempt from the Petroleum Tax, and the special import duty rate -- i.e., ¥125/kl, or 8.6 ¢/bbl, over the [illegible] of ¥2,150/kl, or $1.49/bbl -- is applied to the imported naphtha.

The agency says that the issue is subject to a final recommendation by the Industrial Structure Council's Petrochemical Industry Committee, which is expected to submit its report to the MITI minister around June of this year.

The Petroleum Association's Position

The Petroleum Association of Japan also recently outlined its position on the naphtha issue. The association believes that any problems concerning a particular product should be dealt with collectively for all products, due to the interdependent nature of refinery yields and the importance of following the annual Petroleum Supply Plan worked out by the Natural Resources & Energy Agency and the industry and endorsed by the Petroleum Council.

Also, because petroleum refining and petrochemical companies have joint equity or operating arrangements, the association feels that the problem of supply and pricing of naphtha should be decided between the companies concerned, and not by the industries as opposing groups.

Perhaps the association's most persuasive argument is that, in many cases, overseas suppliers require that buyers purchase naphtha and crude oil together. The association observes that, if petrochemical companies begin importing naphtha themselves, it might disrupt oil companies' supply planning, and weaken their bargaining power vis-a-vis the suppliers.

Japanese Oil Exploration and Development Activities

Japan Oil Development Co. (JODCO) is now carrying out four projects off Abu Dhabi, producing oil & gas and concurrently continuing exploration & development. These projects are:

- Participation in ADMA (Abu Dhabi Marine Areas) operations, producing oil & gas from the Umm Shaif and Zakum (Lower) oilfields
- Development of the Zakum Upper oilfield
- Exploration & development of the Umm Al-Dalkh structure
- Exploration & development of the Satah/Jarnain/Dalma structures

(1) Participation in ADMA Operations

Prior to establishment of the company on February 22, 1973, an agreement was signed on December 26, 1972, between BP and a Japanese oil consortium with regard to Japan's purchase of 45% of BP's equity interests in ADMA for approximately US$780 million. JODCO inherited the agreement upon the company establishment. With the Abu Dhabi government's participation in ADMA raised to 60%, effective September 13, 1974, JODCO's equity share in the entire operation eventually became 12%, as shown below:

	%	% Share
Abu Dhabi National Oil Co. (ADNOC)		60
Abu Dhabi Marine Areas Ltd. (ADMA)		40
- CFP (1/3)	13	
- BP-JODCO (2/3)	26	
	40	
. BP (55%)	14	
. JODCO (45%)	12	
	26	

[illegible] gas production and exploration & development as well are being [illegible] over an area totaling 11,159 km² (4,310 sq mi) by ADMA-Opera[illegible] in accordance with the Implementing Agreement signed on Apr [illegible]

The Umm Shaif oilfield (Arab Thamama Zones) is now producing 200,000 b/d of oil and 250 mmcfd of gas, with the cumulative production as of the end of 1981 having reached 1,085 million bbls of oil and 1,391 billion cu ft of gas. Meanwhile, the Zakum oilfield (Thamama Lower Zone) is now producing 180,000 b/d of oil and 160 mmcfd of gas, with the cumulative production having reached 843 million bbls of oil and 807 billion cu ft of gas.

[illegible] gas production from the two oilfields is shipped to the Das Island [illegible] subsequent processing and loading into ocean-going tankers. The water injection technology is now being applied to the Arab Zone of the Umm Shaif oilfield and to the Thamama IV Zone of the Zakum oilfield. A total of ten rigs are now in operation, including the Tokyo-based Japan Drilling Co.'s Hakuryu [illegible]

[illegible] below are the oil production and JODCO's liftings for shipment in the past nine-year period:

[illegible] 1,000 [illegible]

[illegible]	Production			JODCO's Lifting		
	Umm Shaif	Zakum	Total	Umm Shaif	Zakum	Total
1973	202	305	507	41.2	55.3	96.5
1974	192	270	462	72.9	101.2	174.1
1975	179	243	422	46.7	66.7	113.4
1976	198	250	448	41.8	53.1	94.9
1977	288	234	522	51.7	48.6	100.3
1978	249	246	495	56.2	45.1	101.3
1979	249	241	490	40.3	43.1	83.4
1980	255	249	504	30.8	63.2	94.0
1981	228	227	455	46.6	26.7	73.3
Cumulative, mil. bbls	745	827	1,572	156.0	184.0	340.0

[illegible] place of the Umm Shaif oilfield is estimated at [illegible] the Zakum oilfield is 13.7 billion bbls. The peak [illegible] the [illegible] is expected to reach 570,000 b/d.

[illegible] the Zakum Upper Oilfield

[illegible] extending a financial support to development of the Zakum Upper oilfield [illegible] Zones) by assuming a 12 percent share of expenditures with Zakum Development Co. (ZADCO) as the operator. ZADCO was established in November 1977 jointly by CFP and ADNOC on a 50:50 basis, while development expenditures estimated to total $5,000 million will actually be shouldered by ADNOC and JODCO on an 88:12 basis in favor of ADNOC. The water injection technology will be applied to develop the oilfield.

Commercial production will be started toward the end of this year, at the initial rate of 150,000 b/d. The rate of production is expected to be increased to 500,000-700,000 b/d in two or three years. The oil thus produced will be shipped to the Zirku Island for loading into tankers. JODCO's equity oil share will be 12% of the total production. The original oil in place is estimated at as much as 40 billion bbls. A total eight rigs are now in operation for this project, having drilled more than 100 wells including water injection wells.

(3) Exploration and Development of the Umm Al-Dalkh Structure

ADNOC and JODCO established a joint company, Umm Al-Dalkh Development Co. (UDECO), on January 1, 1979, on a 50:50 basis, to carry out exploration & development of the Umm Al-Dalkh structure (Mishrif Zone), with ADNOC and JODCO sharing the expenditures on an 88:12 basis in favor of ADNOC.

A total of 27 delineation wells have been drilled, including four wells which had been drilled by ADMA during the 1970-1972 period and five wells drilled by JODCO prior to the formation of UDECO. Drilling of the 28th and 29th wells is now under way, with two rigs -- Offshore No.54 and Hakuryu No.7.

Commercial production is expected to begin shortly. Expenditures totaling $700 - 800 million will be required to develop the oilfield. The original oil in place is estimated at around 800 million bbls.

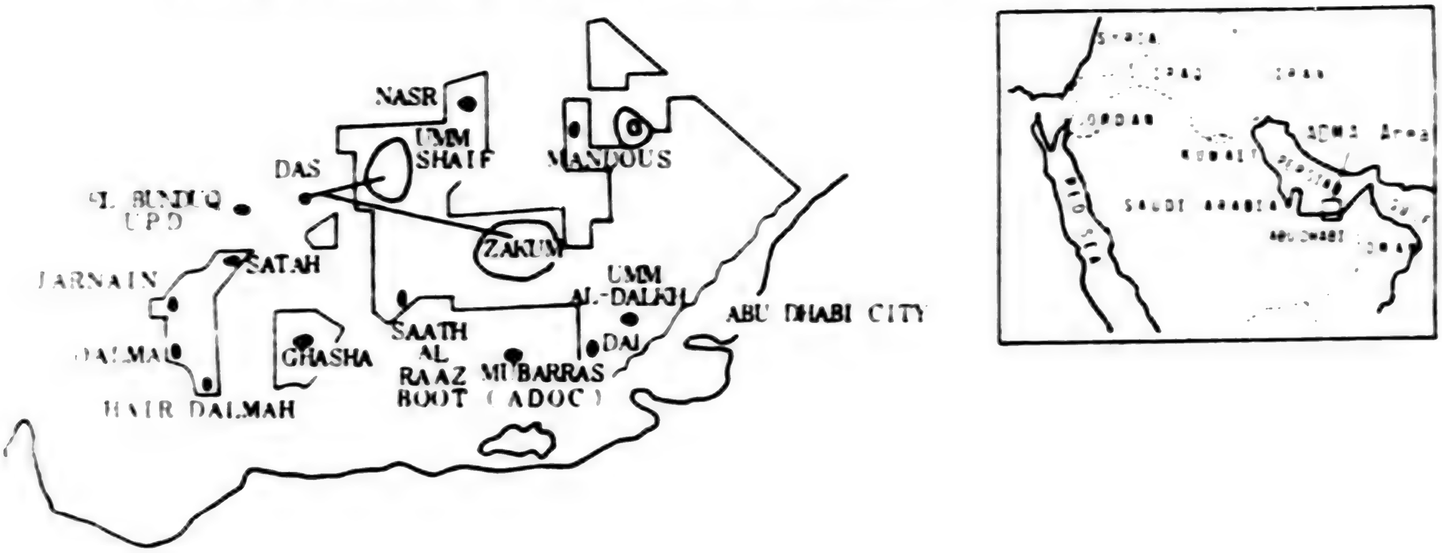
(4) Exploration and Development of the Satah/Jarnain/Dalma Structures -- Dalma Project

Called the Dalma Project, exploration & development of Satah/Jarnain/Dalma structures (Arab C & D Zones) has been under way, with UDECO as the operator. Five wells have been drilled, with the sixth well now being drilled, while one well each has been drilled in the Jarnain and Dalma structures, with two rigs including Hakuryu No.8. Expenditures totaling $1,000 million will be required for the Dalma Project. The original oil in place is estimated at around 800 million bbls.

JODCO is presently capitalized at ¥93,300 million ($406 million), with ten shareholders having equity interests as shown below:

Shareholder	¥ Million	% Share
Japan National Oil Corp.	65,300	70.0
Overseas Petroleum Corp.	13,068	14.0
Fuyo Petroleum Development Co.	2,333	2.5
Mitsubishi Petroleum Development Co.	2,333	2.5
Mitsui Oil Exploration Co.	2,333	2.5
Sumitomo Petroleum Development Co.	2,333	2.5
Toyo Oil Development Corp.	2,333	2.5
World Energy Development Co.	2,333	2.5
Japan Petroleum Exploration Co.	467	0.5
Teikoku Oil Co.	467	0.5
	93,300	100.0

JODCO's Production & Exploration/Development Areas off Abu Dhabi



CRUDE OIL BURNING BY ELECTRIC UTILITIES - PURCHASE BASIS

(Unit:1,000 kl)

Fiscal 1979	Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushu	Total
Arabian light	-	-	-	-	6	-	-	-	-	6
Arabian medium	-	-	-	-	36	-	-	-	153	189
Arjuna	-	44	-	189	-	48	-	-	-	281
Attaka	-	30	-	-	-	-	-	-	-	30
Bekapai	-	-	-	22	-	-	60	-	-	82
Bintulu	-	-	-	-	-	26	-	-	-	26
Brunei blend	3	-	-	-	-	-	-	-	-	3
Champion	-	63	-	157	3	-	-	-	-	223
[illegible]	-	226	-	-	118	-	-	100	-	444
[illegible]	-	-	-	-	1	-	-	-	-	1
Handil	-	555	-	721	289	938	268	14	107	2,892
Labuan	-	-	-	39	-	-	-	-	-	39
Minas	-	69	2,003	578	32	988	-	-	236	3,906
Murban	-	-	-	67	-	-	-	-	-	67
Oman	-	-	-	-	1	-	-	-	-	1
Seria/New Seria	-	15	641	543	3	500	-	-	-	1,702
Taching	28	485	307	860	392	1,379	300	206	153	4,110
Tapis blend	-	-	-	37	-	-	-	-	-	37
[illegible]	-	19	-	-	-	-	-	-	-	19
	31	1,506	2,951	3,213	881	3,879	628	320	649	14,058

Fiscal 1980

Arabian light	-	-	-	-	15	-	-	-	24	39
Arabian medium	-	-	-	-	24	-	-	-	161	185
Arimbi	-	-	-	-	-	49	-	-	-	49
Arjuna	-	28	-	352	-	125	-	114	8	627
Attaka	-	63	236	-	-	83	-	-	-	362
Basrah light	-	-	-	-	1	-	-	-	-	1
Basrah medium	-	-	-	-	7	-	-	-	-	7
Bekapai	-	2	-	-	-	-	78	-	-	80
Bunju	-	21	-	-	-	-	-	-	-	21
Champion	11	225	-	187	-	109	-	14	-	546
Cinta	-	78	-	-	120	41	-	78	13	330
Duri	-	-	-	-	2	-	-	-	16	18
Handil	-	682	-	952	313	1,042	264	13	165	3,411
Iranian heavy	-	-	27	-	-	-	-	-	-	27
Jatibarang	-	-	-	-	-	94	-	-	-	94
Labuan	-	-	-	41	-	-	-	-	-	41
Minas	-	38	2,893	296	70	1,355	-	2	276	4,930
Miri light	-	-	-	206	-	-	-	-	-	206
Murban	-	-	-	21	-	-	-	-	-	21
Oman	-	-	-	243	11	-	-	-	-	254
Seria/New Seria	-	35	1,603	739	-	1,068	-	-	-	3,445
Taching	29	407	410	692	377	1,296	309	199	132	3,851
Tapis blend	-	-	-	22	-	-	-	-	-	22
Udang	-	11	-	1	-	-	-	-	-	12
	40	1,590	5,169	3,752	940	5,262	651	420	775	18,599

CSO: 4120/192

REPORT ON LONG-TERM PLANNING FOR INDUSTRIAL TECHNOLOGY

Tokyo DIGEST OF JAPANESE INDUSTRY & TECHNOLOGY in English No 167, 81
pp 27-32

/For Part I see JPRS 79893, 19 Jan 82 No 142 of this series p 44/

[Text]

The Agency of Industrial Science and Technology (AIST) established the Long-term Planning Study Group for Industrial Technology Development, a private advisory committee under the Director-General of AIST in September 1977. Since then, it has performed a series of new strategic research and analysis on technical development problems essential to the development of the Japanese industrial community and surveys necessary for formation of industrial technology policy over the past four years.

In August 1980, it made an interim report on research and development (R & D) of basic techniques necessary for Japanese industries to tackle immediately.

On the basis of this report, AIST initiated in 1981 the "Basic Technique R & D System for Next Generation Industries" in an attempt to launch development of basic technologies of industries after 1990 through government application of research vitality developed by the private sector.

In addition, this study group held its final meeting on October 9, 1981 and completed a report on "Long-term Planning for Industrial Technology Development – Toward New Research and Development" which is aimed at proceeding with comprehensive and effective R & D as well as future direction of R & D planning until the Year 2000.

This report should be regarded as an indicator of Japan's R & D in the future since it is a report prepared by the AIST Director's private advisory organ.

Furthermore, the first installment of the report appeared on the previous issue of DJIT No. 166.

Technical Advancement Direction

Importance of Basic Technology

In response to technical hopes, our study group has chosen 365 subjects consisting of R&D tasks which should be resolved by the 21st century, especially the important ones.

The study group took up in its interim report (August 1980) the important R&D themes consisting of *"basic technology," "machinery technology"* and *"system technology."* Among them, the important points in basic technology (biotechnology, new materials, new functional objectives, etc.) are listed below.

(1) Since the technology is in the basic development stage, the development risk is large.

Agency of Industrial Science & Technology

The Agency of Industrial Science and Technology, an attached organ of MITI, was established in 1948 to administer Japan's use of technology, thereby promoting the development of natural resources, the modernization of production methods, the upgrading of production technology, the standardization of industry, and the subsidization and encouragement of research and development in Japan's private sector. The Agency was also charged with the setting up of a system for comprehensive research and experimentation in the areas of mining and industrial technology in order to implement the above policies.

Note: **Please see MITI HANDBOOK 81/82 on further details. The handbook can be obtained by sending an attached sheet (see page 46) to our sales department.**

(2) The development result covers a broad field and there is extensive R&D effects.

(3) Basic technology has attracted the attention of the advanced countries because it triggers technical innovation and the technical field is the vanguard of international competition.

(4) Japan has depended considerably on overseas technology in the basic technology field in the past but technical induction will become more difficult in the future.

Because of the importance of basic technology, the Agency of Industrial Science and Technology established in 1981 the "Basic Technique R&D System for Next Generation Industries." The nation has started to utilize the vitality of private research to carry out technical development which will become the industrial foundation after 1990.

Technology Advance Direction

Further analysis will be carried out on technical promotion in three directions on the basis of our interim report. They are "micro-technology," "information technology" and "complex technology."

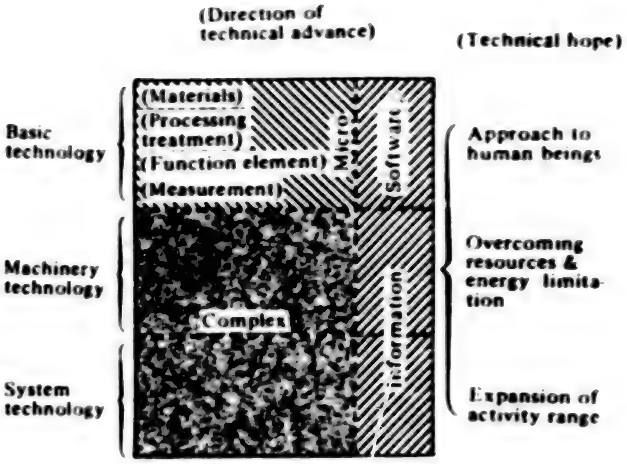
Micro-technology

In the basic technology field, there has been technical progress in processing, treatment and measuring as well as material manipulation in the micro-level field of minute, microscopic and precision technology.

For example, the accuracy of precision and measurement processing in processing and treatment technology has developed to the level of producing super-LSIs which are the size of an atom. This is gradually expanding technical possibilities.

The manipulation of genetics as seen in biotechnology, is expected to make the microscopic world of genetics the direct object of technology. This is expected to lead to the application, etc. of chemical processes of biological functions gradually becoming a big factor in process change.

Fig. 1 Technical Hopes & Direction of Technical Advance

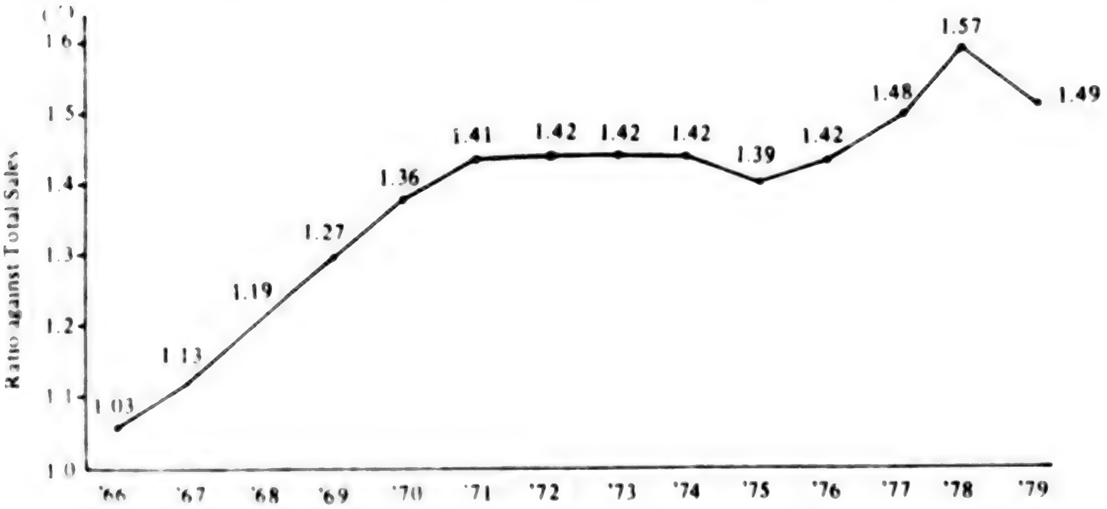


Information Technology

There has been growing understanding of information since the application of the term information society. The transmission and disposal of information or the so-called information technology has continued rapid development.

For example, a look at computer technology shows that in order to realize rapid processing of a large volume of information accurately which is the mission of computation machinery, there has been remarkable development of fast calculation and expansion of memory capacity technology.

Fig. 2 R&D Investment Ratio against Total Sales in Private Enterprises in Japan



Together with the advance of sensor technology and software technology, the computer has advanced from a mere calculator to a machine which recognizes letters and voice patterns. It is able to substitute for the five human senses as well as assure human thinking similar to artificial intelligence and realize functions which are close to judgement functions. This indicates that the computer is moving closer to humans in advanced information processing.

In the field of transmitting information, there were telegraph and telephones, etc., in the past or the so-called communications service (information transmission means). But today, information has a major social value and there has been strong anticipation toward a much larger volume of information transmission which has led to remarkable developments of information transmission technology such as optical fiber and laser technology.

Apart from communications and computers connected with information, genetics accommodating information is utilized in rearranging DNA in biotechnology. There is a trend toward expanding the boundary of information with technology as the object.

Complex Technology

The machinery and equipment existing around us or systems demonstrate their functions under complex technology on the parts level or machinery and equipment level. In looking especially at the products, there has been an increase of items together with the progress of complex technology and complex and advanced technology has been achieved as seen in artificial satellites, etc.

Recently, there has been an advance in industrial robots, numerically controlled machine tools, etc., which cover electric machines and system technology known as mechatronics. At the same time, the application of computers and micro-computers which are sustained by the advance of semi-conductor technology and the adaptation of these machines to past machinery and systems have resulted in the realization of higher performance and diverse functions.

The course of complex technology has been detected up to now amid a major technical trend from the past. This course is expected to grow in the future with rapid development of electronics, computers, etc.

As mentioned above this study group has seized the three fields of "micro-technology," "information technology" and "complex technology" as the technical course of advancement in the future.

Fig. 1 was prepared to indicate the relation between essential technology and the hopes toward technology.

In order to respond to the technical hopes toward "approaching humans," "overcoming energy resource limitations" and "expansion of operational room" it is important to draw out effective technical progress mainly in micro-technology, the basic technology field which is sustained by the information technology as well as complex technology which sustains machinery and equipment and the system technology field.

System Technology

Direction of Research and Development

On the basis of the future technical trend which has become clear so far, the following is a summary of the direction indicated in Japan's R&D.

(1) Future R&D will take a course of technical hopes on "Approach to Human Beings," "Overcoming Resource and Energy Limitations" and "Expansion of Activity Range" adapting well with "Micro-technology," "Information Technology" and "Complex Technology."

(2) In the case of essential technology which is basic technology represented by biotechnology, new materials and new functional elements are expected to bring about epoch-making technical innovation in the next generation. They are expected to become the object of important R&D in the future.

(3) In looking at the substance of the important research and development tasks of the future, the major task appears to be the establishment of Japan's independent and own technology.

(4) In order to achieve this goal, it is necessary to raise the weight of basic research in the R&D stage and to develop practical results. This will make it necessary to carry out a long period of research.

(5) The technology born from this research process must contribute to the development of our country as well as the world economy. The results must be carried out as industrial ownership rights so that the research can be advanced to materialize on an international scale. It is important for technical exchange to be promoted smoothly with the U.S. and European industrially-advanced countries through cross-licenses, etc., on the basis of international industrial proprietary rights.

At the same time, the technical exchanges will make it possible to deepen and expand Japan's technical foundation.

Promotion Structure of R&D

On the basis of the study so far, the following will be a report on the roles of our country and universities centering on key private enterprises in connection with the R&D promotion structure of Japan in the future.

Strengthening R&D in Private Enterprises

(1) A look at the present R&D situation shows that private businesses utilize about 65.3 percent of our country's total R&D funds. They also have 55.8 percent of Japan's total number of researchers. It could be said that private enterprises are the main promoters of Japan's R&D program.

The total amount of R&D investments of private enterprises which play the main role in R&D has grown smoothly. Although the sales ratio dropped in 1979, there has been a gradual increase in general. It can be confirmed that private enterprises are making major efforts in R&D investments (Fig. 2).

However, a comparison of R&D investments of private businesses of the leading countries of the world shows that the share of R&D funds from the sales ratio for all industries is virtually one-half of the U.S. and West Germany by industry, only food and textiles are higher than the U.S. (excluding man-made fiber) and steel. Compared with West Germany, Japan is higher only in the steel category. There is a big difference between Japan and other advanced countries in comparing R&D investments by private enterprises.

(2) A study of Japan's R&D life cycle (average R&D period) shows that this country's period is three to four years which is only about half of the six to eight years of other countries. It is surmised that Japan's R&D activities put more weight on the practical stage which is based on technical induction of foreign basic patents, etc.

R&D Life-cycle in Major Advanced Countries

Japan	3.5 (year)
U.S.A.	7.4
Britain	6.7
West Germany	5.6
France	7.3

Note: average during 1953 to 1973

[illegible] [illegible]ly of the investment ratio by stages of private [illegible] R&D funds indicate a decreasing trend in the [illegible] research funds. There is uneasiness in the [illegible] Japan's technical innovation (Fig. 3).

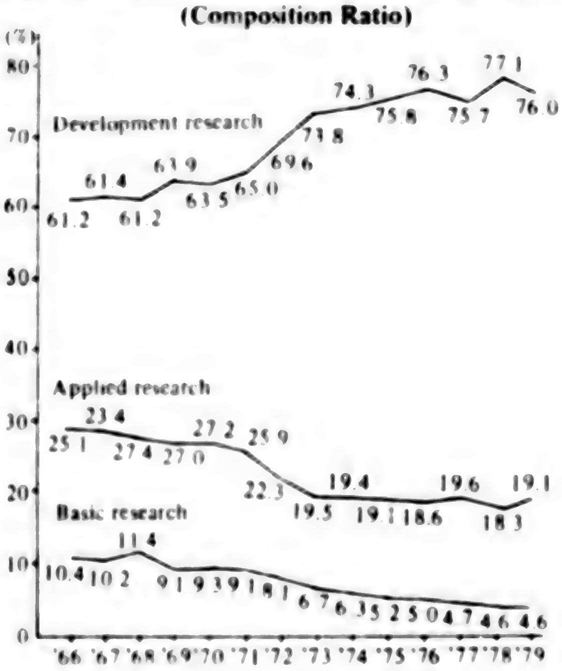
Foreign countries are paying major attention to Japan's high technical standard as well as management [illegible] and industrial vitality, etc., which are mainly [illegible] production technology field as a result of the [illegible] international competitive power of Japanese [illegible] manufactured by Japanese businesses. These [illegible] for this country to take the lead in the future [illegible] world's technical innovation by making use of [illegible] technical standards and industrial vitality as well as [illegible] abundant research talent resource.

Therefore, Japan should give full consideration to the "Research and Development Direction" mentioned earlier and carry out brisk R&D investments from the long-term viewpoint, especially there should be efforts to complete basic research and promote R&D aimed at establishment of independent technology.

Organic Cooperation among Industry, Academic and Government Circles

As mentioned earlier, it could be considered that the main promotion of R&D in this country is private business. With the advancement of technology as well as complex and large-scale development, it will become very important for Japan's R&D to further promote R&D on a basic, academic and industrial basis. In order to achieve this goal, it is necessary for private businesses to make efforts for organic cooperation with the Government institutions and universities. This report will deal next with the role of universities and the Government institutions which support the R&D promotion structure in which private businesses play the key role.

Fig. 3 R&D Investment in Private Enterprises by Research (Composition Ratio)



The Role of Universities

The university plays a major role in carrying out R&D activities. One role is to produce research results in basic science and the other is to train research talents and provide them to private businesses.

These contributions will play a major role in raising the general level of R&D standards in this country. It is hoped that in the future, the university will produce greater creative research results because it uses one-third of the total number of researchers and about 65 percent of the basic research expenses. However, the research expense per researcher in a university is only about one-half of that of private industries. It is necessary to improve this aspect from the standpoint of substantiating basic research.

The Role of Government Institutions

(1) Adjustment of R&D Environment in Private Business

In promoting the nation's R&D program, the state's role has emphasized adjustment of the environment to put vitality in the R&D activities of private businesses which is the main body of R&D. Since R&D will play an important role in the future, the Government is expected to play an increasing role in this field. There is need to establish basic research, strengthen cooperation among industrial, academic and government circles and carry out international cooperation as well as broad policies both at home and abroad.

Therefore, it is important for the Government to carry out its policies with emphasis on the following points.

(a) To indicate the direction of future R&D by announcing the nation's industrial and economic course through an industrial structure vision, etc.

(b) In order to activate R&D of private enterprises, the Government should provide subsidies, special tax treatment monetary measures, etc., for private R&D programs.

(c) The Government should increase its share of burdens to cope with the expansion of R&D investments by private businesses. The U.S. and the European countries have emphasized government R&D investments in defense-related industries such as aircraft, electronics and the electric industry. But in the case of the Japanese Government, there is a big difference in the R&D investment pattern.

Even if the Government's R&D investments are excluded from the defense-related field, Japan's research funds are much lower than the U.S. and the European countries when an international comparison is made. Therefore, it is important for Japan to carry out a major increase of its R&D funds.

(d) It has become especially clear that the Government should provide funds for R&D to promote the aircraft industry, space industry, atomic energy machinery industry, machinery industry and the electronics industry which are based on micro-technology, information technology and complex technology. It is also necessary to pour state funds for R&D in the development of the mining industry, etc., which are resources-related industries from the standpoint of stabilizing the resources supply.

Through these measures, it will be possible to activate the raw material industry in chemicals, steel, nonferrous metals, ceramics, etc., and realize technology transfer between industries. There is also need for the Government to provide funds for R&D of research facilities and machinery in basic research for advanced technology.

However, in the case of industries which are based on micro-technology, information technology and complex technology, attention should be paid to the fact that the U.S. and European countries also hope that they will be the motive in national economic development. Therefore, it is desirable to expand joint R&D internationally in such fields as the aircraft industry.

In the case of resources-related industries, it is necessary to consider technical transfer, research cooperation and technical cooperation with developing countries, most of which possess natural resources. In this manner, the Japanese Government's role is expected to increase in the development of international-scale R&D.

(e) There have been considerable results in cooperation between national laboratories and research institutions and private business. Especially, the laboratories of the industrial technology institutes have contributed to the vitality of private R&D through technical guidance and technical transfer of research results to private business.

In the future, it is necessary for research laboratories to promote positive utilization of research results by private businesses as well as carry out joint research, technical exchange, etc. on a regular basis. ■

Note. This translation into English is tentative. Accordingly, detail and accurate inquiries on the report should be directed to the Agency. — **Editor**

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LONG-TERM INDUSTRIAL TECHNOLOGY DEVELOPMENT POLICY EXAMINED

Tokyo SANGYO GIJUTSU KAIHATSU CHOKI KEIKAKU SAKUTEI KENKYUKAI HOKOKU in Japanese 9 Oct 81 pp 1-63 and I-IV

[Report of the Research Committee for a Long-Term Industrial Technology Development Policy]

[Text] Introduction

The 1980's is an era of competitive technological development.

Since the end of World War II, Japan has achieved economic growth and strived to improve the national standard of living based on a national policy of a peaceful nation. In order to accomplish this, however, we were tremendously benefited by technological innovations. After the war, Japan was able to improve its technological standards through importing technologies from the advanced Western countries, upgrading its industries, and strengthening its international competitive power. On the other hand, it succeeded in making the Japanese people's lives more comfortable by supplying durable consumer products such as automobiles and home electric appliances in abundance. This has shown that the national economy can be improved by means of peaceful uses of technology. From the 1980's on, the international climate surrounding Japan will become increasingly complex and diversified, and the restrictions on resources and energy will become greater. Our peaceful effort to deal with this will be more crucial than ever. Technology is one method which will help to meet these problems effectively and usefully, and it is our responsibility to deal with this climate positively, since Japan is a peaceful country and a great economic nation.

Japan has been leading the world technological innovations by taking advantage of its experience in the peaceful use of technology; however, we would like to do our utmost in the future also so as to make the peaceful use of technology universal. In order to carry out the essential mission of technology, which is to provide for the happiness of mankind, Japan must take the initiative in further promoting the development of technology.

Based on a critical attitude, this research committee, a private advisory body to the chairman of the Agency of Industrial Science and Technology, has examined the path of future R&D, and has studied the topics and promotional system of R&D for the 4 years since 1977. In August last year, we made an interim report on the significance of "basic technologies" as a topic of R&D, and we compiled "The Next-Generation Basic Industrial Technology R&D System." We hereby submit a final report on the promotional structure for R&D.

This report is based upon our recognition of the present status of Japan's production technologies. Japan's technological standards have reached a high level internationally. However, in terms of technological development forces, further efforts are needed in the future. Therefore, we present the following proposals:

1) The private sector will take the initiative in R&D in cooperation with universities and national research institutes.

2) Joint international research or technology transfer will be promoted for those industrial technologies which require further development in the future.

We wish to have the Agency of Industrial Science and Technology to carry out these proposals in cooperation with various organizations concerned.

We would like to express our gratitude for the cooperation given by the committee members and private "think tanks" in compiling the present report.

9 October 1981
Yujiro Hayashi, Committee Chairman

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Outline

I. R&D and Industrial Development

1. R&D activitires contribute to the high value added of industries.

2. Intensive R&D oriented industries have a larger relative export rate and their investments in R&D contribute to the improvement of international competitive power.

II. Current R&D Status of Japan

1. Status of R&D

1) In FY-79, Japan's R&D is ranked second highest (more than 4 trillion yen) in the free world; however, its proportion relative to GNP is at a low level (1.82 percent). The proportion of R&D investments in basic research is low (Japan's percentage among the total investments in basic research conducted by five countries, i.e., Japan, the United States, West Germany, England and France, is 16.5 percent (1977) ranking third after the United States and West Germany).

2) The number of Japanese researchers is the second largest (more than 300,000) in the free world; however, R&D expenditure per researcher (approximately 14 million yen in FY-79) is not better than that of Europe and the United States (approximately half of the latter).

2. Status of Technological Standards

Japan's technological standards have been rapidly rising in international terms and its R&D forces have also shown some improvement But aside from Japan's production technology, its technological standards in the area of basic technologies are still behind those of foreign countries, and outstanding technological innovations are few.

III. Directions of R&D

1. In order to achieve the new national goals--(1) international contribution based on a "great economic nation," (2) overcoming of the restrictions on a "small resources nation," and (3) compatibility of "vitality" and "comfort," proposed by "MITI's Vision of the 1990's"--the following is expected from technology: (1) "mechanization of human functions," (2) "overcoming of resource and energy restrictions," and (3) "expansion into space and ocean."

2. In response to these three expectations from technology, we have selected 365 major R&D topics with cooperation from industries and academia.

After examining the above major R&D topics, we propose the following as the future directions of technology:

"Micro Technologies" (gene splicing technology, three-dimensional circuit elements, etc)

"Information Technologies" (artificial intelligence, optical information system, remote sensors, etc)

"Compound Technologies" (fully-automated plants, deep submarine resources collection system, etc)

IV. Structure of R&D Promotion

1. Strengthening of R&D by Private Sector

1) The percentage of R&D investment by the private sector (its proportion to sales) is low compared to that of the United States and West Germany (approximately one-half).

   Also, since basic research expenditure is declining, Japan's future technological innovations seem uncertain.

2) Accordingly, from the standpoint of leading the technological innovations in the world, the private sector must activate R&D investments, consolidate basic research in particular, and promote R&D aimed at the establishment of independent technology.

2. Systematic Cooperation Among Industries, Academia and the Government

1) It is necessary for the private sector to efficiently promote R&D while cooperating with universities and the government.

2) Role of Universities

   (1) Train researchers and supply them to the private sector.

   (2) Produce research results in the area of basic science and transfer technological results to the private sector.

   (3) Support R&D by the private sector through industry-academia cooperation.

3) Role of the Government

   (1) Consolidate environment in order to vitalize R&D activities by the private sector.

      a) Cite guidelines for technological development.

      b) Provide the private sector with preferential measures by means of subsidy, taxation, and finance.

c) Since the proportion of R&D expenditure shared by the government is low compared with that of Europe and the United States (in Europe and the United States, about 50 percent; in Japan, about 30 percent), an effort must be made to greatly increase the proportion.

d) The national experiment and research agencies will transfer their technological results to the private sector.

e) Promote international development of R&D such as technological exchange, technological transfer, research cooperation, etc.

f) Make an effort to consolidate the environment so that technologies will be accepted by the society (TA and PA).

(2) R&D activities conducted by the government

a) The government will take the initiative in the areas of R&D (large projects, the "Sunshine" project, the "Moonlight" project, the next generation technologies, etc) which require a long period of time, a great amount of funding, are greatly needed by the society, and in those areas where smooth technological development is difficult by the private sector alone.

b) The national experiment and research agencies will principally promote R&D conducted by the government.

[illegible]

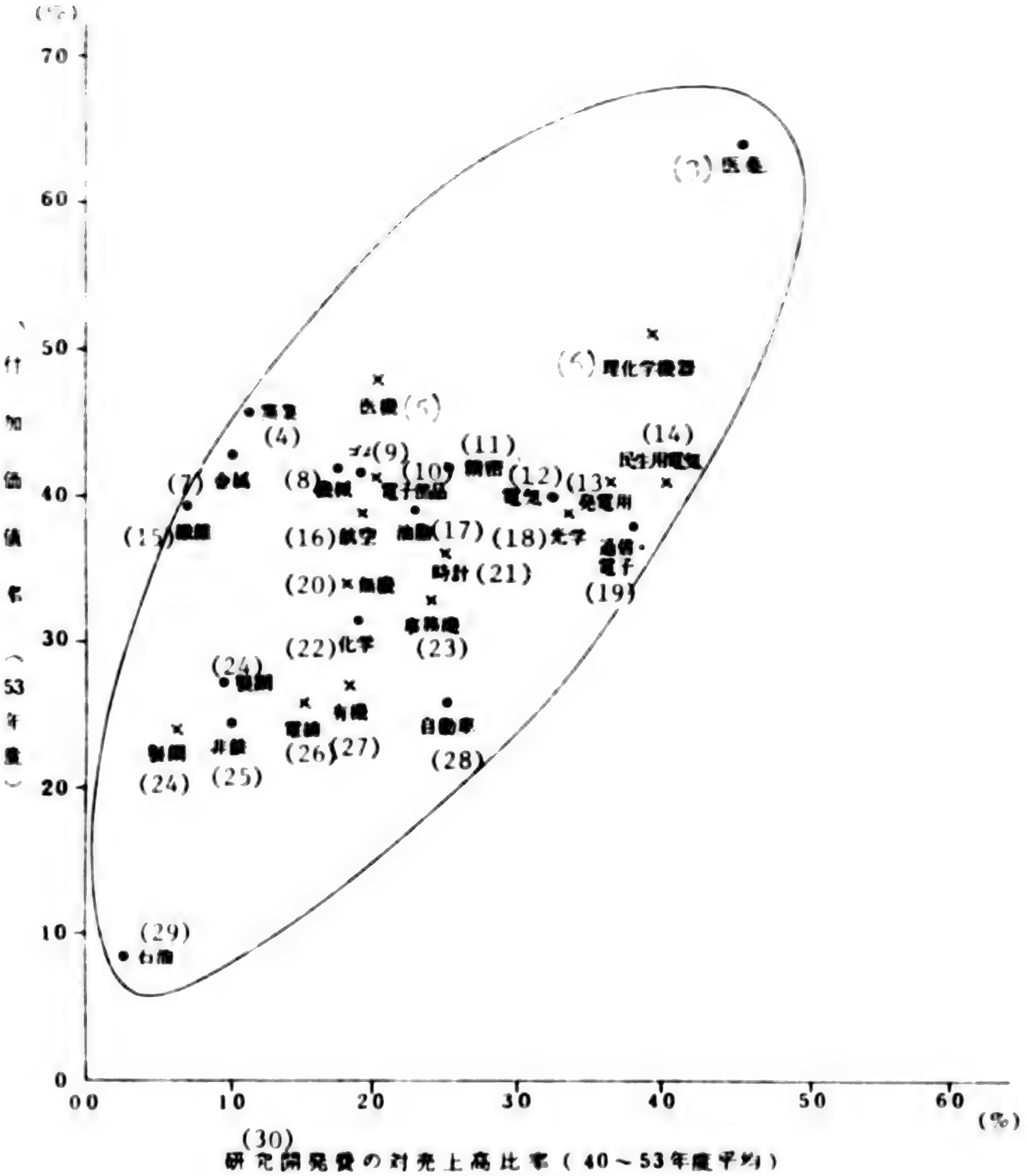
Chapter 1. R&D and Industrial Development
Chapter 2. Current Status of R&D in Japan
Chapter 3. Directions of R&D
Chapter 4. Structure of R&D Promotion

Chapter 1. R&D and Industrial Development

It is generally acknowedged that technological innovations have contributed [illegible] to the development of industries. Furthermore, technological innovations are the result of R&D. Consequently, R&D activities are strongly related to the development of industries, and specifically to the sophistication of industries and to the improvement of international competitive power.

When the vitality of R&D activities are represented by R&D investment (proportion of R&D expenses to sales), and the relation to the value added rate [illegible] sought (Figure 1-1), the so-called intensive R&D oriented industries--[illegible] with greater R&D investment, such as electric equipment and medical and precision equipment--have higher value added rates, showing a positive correlation. Therefore, it is conceivable that R&D activities hold the major key [illegible] high value added which is the goal of industries.

(1) 図1－1　研究開発投資と付加価値率



(31)(注)　(1)　・印は中分類，×印は中分類の細分化

(2)　付加価値率＝付加価値額／製品出荷額×１００（%）

（付加価値額，製品出荷額は工業統計データ）

(32) 出典：科学技術研究調査報告

工業統計表（産業編５３年版）

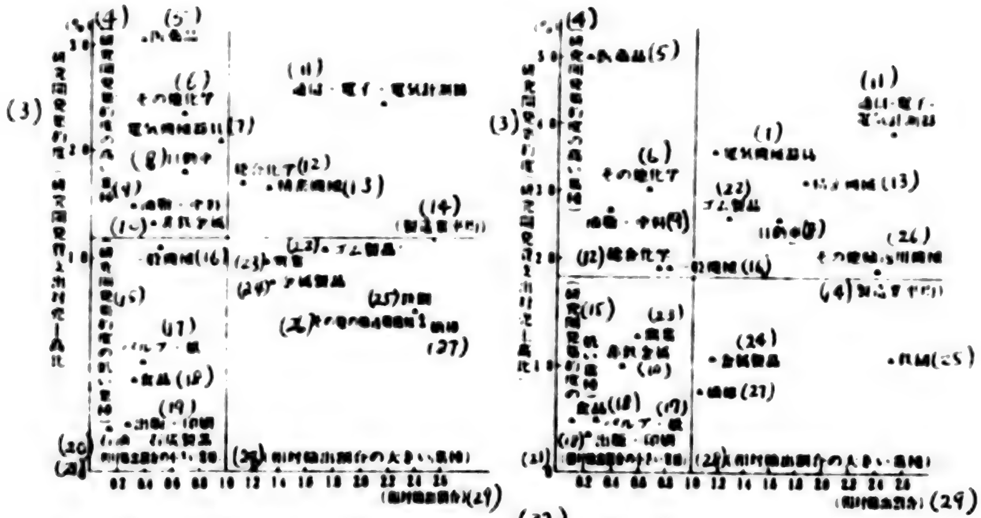
Key: [to Figure 1-1]

(1) Figure 1-1. R&D Investments and Value Added Rate
(2) Value added rate (FY-78)
(3) Pharmaceuticals
(4) Ceramics
(5) Medical equipment
(6) Physical and chemical equipment
(7) Metals
(8) Machinery
(9) Rubber
(10) Electronics parts
(11) Precision
(12) Electric
(13) For power generation
(14) Household electric
(15) Textiles
(16) Aviation
(17) Oil and fat
(18) Optics
(19) Communications and electronics
(20) Inorganic
(21) Watches
(22) Chemicals
(23) Office equipment
(24) Steel
(25) Nonferrous
(26) Electric wire
(27) Organic
(28) Automobiles
(29) Petroleum
(30) Proportion of R&D expenditure to sales (average during FY-65 to FY-78)
(31) (Note) 1) ● Medium category
x Subdivision of medium category

2) Value added rate = value added amount/product shipment amount x 100 percent (value added amount and product shipment amount are based on industrial statistical data)

Source: Scientific Technology Research Survey Report
Industrial Statistics (Industry volume, 1978)

(1)図１－２　研究開発集約度と相対輸出割合



(2) (1)　４０年度

(31) (2)　５３年度

(30) (注)　1　研究開発費支出対売上高比は４０年度。
2　相対輸出割合＝（ＯＥＣＤ加盟国の当該業種の輸出額に占める日本の割合）＋（ＯＥＣＤ加盟国の総輸出に占める日本の割合）
輸出額は４０年。
3　科学技術研究調査報告，ＯＥＣＤ－Ｃ統計より作成。

(32) (注)　1　研究開発費支出対売上高比は５３年度。
2．相対輸出割合＝（ＯＥＣＤ加盟国の当該業種の輸出額に占める日本の割合）＋（ＯＥＣＤ加盟国の総輸出に占める日本の割合）
輸出額は５１～５２年平均。
3．科学技術研究調査報告，ＯＥＣＤ－Ｃ統計より作成。

(33) 出典：通商白書（昭和５５年版）

Key [to figure 1-2]

(1) Figure 1-2. Intensive Degree of R&D and Proportion of Relative Exports
(2) FY-65
(3) Intensive degree of R&D (proportion of R&D expenses to sales)
(4) (Industries with higher intensive degree of R&D)
(5) Pharmaceuticals
(6) Other chemicals
(7) Electric equipment and appliances
(8) Automobiles
(9) Oil and fat; paints
(10) Nonferrous metals
(11) Communications, electronics, and electric measuring apparatus
(12) General chemicals

[key continued]

[Continuation of Figure 1-2 key]

(13) Precision machinery
(14) (Average of manufacturing industry)
(15) (Industries with lower intensive degree of R&D)
(16) General machinery
(17) Pulp, paper
(18) Foods
(19) Publications, printing
(20) Petroleum, coal products
(21) (Industries with smaller proportion of relative exports)
(22) Rubber products
(23) Ceramics
(24) Metal products
(25) Steel
(26) Other transportation machinery
(27) Textiles
(28) (Industries with larger proportion of relative exports)
(29) (Proportion of relative exports)
(30) (Note) 1. Proportion of R&D expenditure to sales is that of FY-65.
    2. Proportion of relative exports = (Japan's share in the export amount of OECD countries' industrial exports) : (Japan's share in the total exports of OECD countries Export amount is 1965.
    3. Compiled by Scientific Technology Survey Report and OECD-C Statistics.
(31) (2) FY-78
(32) (Note) 1. Proportion of R&D expenditure to sales is that of FY-78.
    2. Proportion of relative exports = (Japan's share in the export amount of OECD countries' industrial exports) : (Japan's share in the total exports of OECD countries) Export amount is an average of 1976 77.
    3. Compiled by Scientific Technology Survey Report and OECD-C Statistics.
(33) Source: MITI white paper (1980)

2) Concerning the relationships between R&D activities and international competitive power (product trade) (Figure 1-2), in FY-65, industries with a lower intensive degree of R&D had a larger relative export rate, but in FY-78, industries with a higher intensive degree of R&D showed a greater relative export rate. With respect to electric equipment, communications and electronics equipment, and automobiles, which had a relatively higher intensive degree of R&D in the past, R&D investment led to improvement in international competitive power.

3) As mentioned above, we believe that in the long run R&D has greatly contributed to the sophistication of industries and the improvement in international competitive power. For reference, R&D investments in the United States declined from 3.0 percent of its GNP to 2.2 percent between 1964 and 1978; the productivity growth rates during this period dropped compared to those of Japan and West Germany, and its proportion of exports in the world also declined. The United States regards this phenomenon as a result of a decline in R&D, and such a viewpoint suggests the significance of R&D in regard to the sophistication of industries and the improvement of international competitive power.

Chapter 2. R&D Status of Japan

We have already mentioned in the previous chapter that R&D contributes to industrial development. In this chapter, let us discuss the status of R&D in two areas: R&D activities, and one result of these activities, technological standards.

1. Status of R&D Activities in Japan

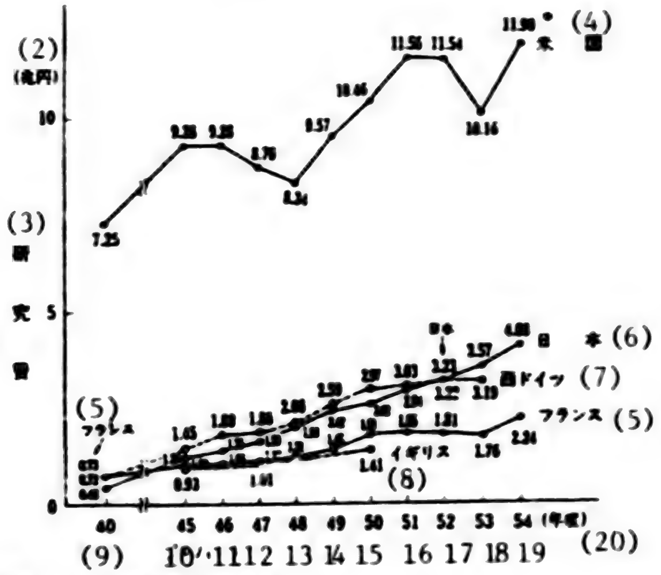
1) R&D Expenditure

(1) In FY-79, Japan's R&D expenditure exceeded 4 trillion yen in total, ranking second in the free world (hereafter, international comparison is based on the free world), exceeded only by the United States (Figure 2-1). However, Japan's R&D expenditures and 1.83 percent of the GNP (Figure 2-2), which is low compared to major advanced countries.

(2) R&D includes a wide range of activities, from obtaining scientific knowledge to industrialization. When these are classified into three stages--basic, application and development (Table 2-1)--Japan's R&D activities are characterized by a relatively higher level of development research than basic research. In other words, while Japan ranks second in total R&D among five major countries, second only to the United States, in basic research it ranks in third place, next to West Germany, and the amount of investment is smaller by far than that of the United States.

(3) In terms of classification by industries (Table 2-2) in Japan, a great part of R&D expenditure is invested in the areas of electric machinery, chemicals, and transport machinery (automobiles), whereas in Europe and the United States, R&D expenditures are characterized by an emphasis on aircraft in addition to those areas.

(1)図２－１　主要国における研究費の推移



(21)注　1.　＊は速報値である。

2.　米国，フランスの研究費は，人文・社会科学を含む。

(22)出典：科学技術白書（昭和５６年版）

Key:
(1) Figure 2-1. Changes in Major Countries' Research Expenditure
(2) (trillion yen)
(3) Research expenses
(4) United States
(5) France
(6) Japan
(7) West Germany
(8) England
(9) 1965
(10) 1970
(11) 1971
(12) 1972
(13) 1973
(14) 1974
(15) 1975
(16) 1976
(17) 1977
(18) 1978
(19) 1979
(20) (Fiscal year)

(21) (Note) 1. *Prompt report value
2. Research expenditure of the United States and France includes that in humanities and social sciences.

(22) Source: Science and Technology Agency white paper (1981)

Table 2-1. Major Countries' R&D Expenses by R&D Stages (1977)

R&D Stages / Countries	Basic		Application		Development		Total	
	100 million yen	%	100 million yen	%	100 million yen	%	100 million yen	%
Japan	5,139	16.5	7,949		18,633		31,721	15.6
United States	14,619	46.9	26,479		74,125		115,223	56.9
England (75)	2,057	6.6	3,249		7,474		12,780	6.3
West Germany	5,528	17.7	19,276				24,804	12.2
France	3,826	12.3	6,243		8,067		18.136	8.9
Total	31,169	100.0	171.495				202,604	100.0

Source: OECD statistics

Table 2-2. Proportion of Major Countries' Research Investments by Industries

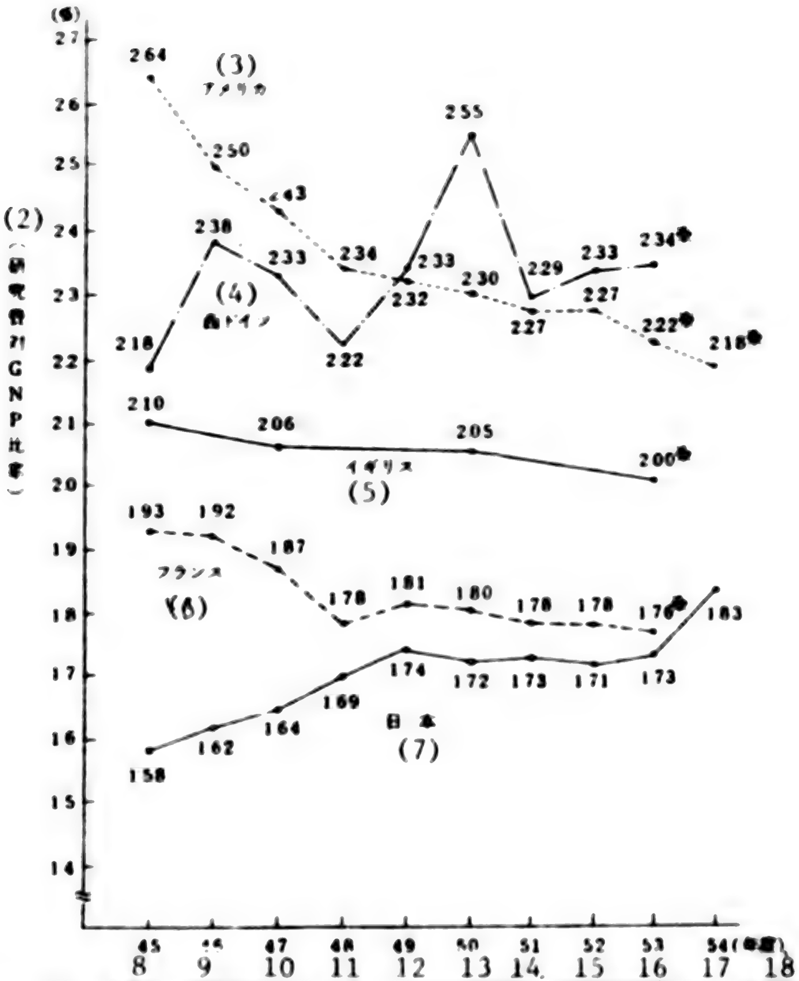
Country, year / Industries	Japan	United States	England	West Germany	France
	1977	1977	1975	1977	1977
Manufacturing industries	91.2	96.8	92.2	92.2	93.0
Aircraft	*	23.7	21.8	7.2	18.6
Electric machinery	23.8	19.9	23.7	26.2	27.7
Chemical	18.3	14.0	17.9	26.9	18.3
Transportation machinery	17.0	11.4	7.8	12.2	11.9
General machinery	8.1	18.0	5.5	14.1	5.0
Others	24.0	9.8	15.5	5.6	11.5
Nonmanufacturing industries	8.8	3.2	7.8	7.8	7.0

Notes: 1. 7.8 percent of West Germany's nonmanufacturing industries includes an unknown 2.0 percent. Japan's data are based on the 1979 Scientific Technology Research Survey Report. Except for Japan and England, data are based on prompt report value

2. * is included in transportation machinery

Source: OECD, "International Statistical Year 1975, 1977";
1979 Scientific Technology Research Survey Report

(1) 図２－２　主要国における研究費の対ＧＮＰ比率推移



(19) (注)　●印は、推定値である。また、イギリスの数値は、OECD統計値とジェトロ調査（53年度）である。名目GNPは、44～49年度が45年度基準値、50～54年度が50年度基準値を使用

(20) 出典　日　本：46～54年科学技術研究調査報告、55年版国民経済計算年報、55年科学技術研究調査結果の概要

アメリカ：IMF「International Financial Statistics 1980」、NSF「National Patterns of R & D Resources (NSF78-313)」

イギリス：IMF「International Financial Statistics 1980」、OECD「International Statistical Year 1975」

西ドイツ：IMFは、同一資料である。連邦研究技術省「Bundesbericht Forschung Ⅳ」

フランス：IMFは、同一資料である。1980年予算法案附属資料

Key: [Figure 2-2]

(1) Figure 2-2. Changes in Major Countries' Research Expenditure in Proportion to GNP
(2) (Proportion of Research Expenditure to GNP)
(3) United States
(4) West Germany
(5) England
(6) France
(7) Japan
(8) 1970
(9) 1971
(10) 1972
(11) 1973
(12) 1974
(13) 1975
(14) 1976
(15) 1977
(16) 1978
(17) 1979
(18) (Fiscal year)
(19) (Note) * Estimated value. The figures for England are based on OECD statistics and JETRO survey (FY-78). For GNP, FY-70 standard is used for FY-69 to FY-74, and FY-80 standard is used for FY-75 to FY-79.
(20) Source: Japan: 1971-79 Scientific Technology Research Survey Reports, 1980 Annual National Economic Computation Report, and a summary of 1980 Scientific Technology Research Survey Results.
United States: IMF, "International Financial Statistics 1980"; NSF, "National Patterns of R&D Resources (NSF 78-313)"
England: IMF, "International Financial Statistics 1980"; OECD, "International Statistical Year 1975"
West Germany: Same IMF data as above. Federal Research and Technology Department "Bunctesbericht Farschung IV."
France: Same IMF data as above. 1980 Budget Bill Appendix data.

2) Number of Researchers

(1) Another key to R&D activities along with R&D expenditure (Figure 2-3) is researchers. As of 1 April 1980, the number of Japanese researchers exceeded 300,000, which is the second largest number in the world after the United States. In terms of the number of researchers per 10,000 of the population (Figure 2-4), the figure is about the same as that of the United States and greater than that of the West European countries. Generally speaking, therefore, Japan's personnel resources in R&D are quite rich.

(2) The amount of R&D expenditure per researcher (Figure 2-5), however, is about half that of the United States and Europe, so it is not favorable in terms of funding.

(3) The composition ratio of researchers by industries (Table 2-3) shows that Japan is on the same level as the United States and Europe in terms of its electric equipment and chemical industries, and higher than Europe in the area of raw material industries such as steel and ceramics. The United States and Europe re characterized by a higher percentage in the area of transport machine industries including aircraft, in addition to electric equipment and chemistry.

2. Japan's Technological Standards

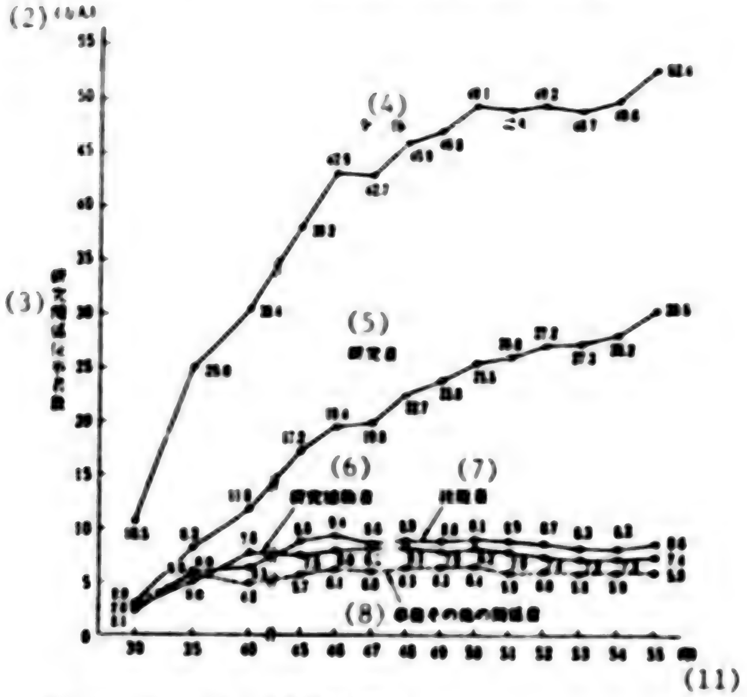
1) Postwar Japan has vigorously imported advanced technologies from foreign countries and has strived to ingest and absorb these in accordance with its goal of catching up with the advanced Western countries.

The number of foreign patent applications by major countries (Figure 2-6) shows that the percentage of Japan's applications doubled from 7 to 14 percent throughout the 1970's, indicating the rapid growth of Japan's technological standards in international terms.

When R&D standards among Japan, the United States, and West Germany are compared on the basis of such indexes as R&D expenditure, number of researchers, number of foreign patent applications, amount of revolutionary technological development, and technology trade, in the latter half of the 1960's and 1970's (Figure 2-7), Japan's R&D forces have improved in the major indexes. Although it has not reached the standards of the United States, as of the latter half of the 1970's, in general, Japan's standards have reached those of West Germany.

2) On the other hand, in regard to the awareness of private enterprises of the technological gap between Japan and foreign countries (Table 2-4), more than half of the steel, ceramics, and precision machine industries rated themselves technologically more advanced than their counterparts abroad, and the majority of other industries also rated themselves more than equal. As mentioned in Chapter 1, such awareness seems to have stemmed from the overall strength of the international competitive power of Japan's products trade.

(1)図２－３　研究関係従事者数の推移



(9) (注)　各年とも4月1日現在

(10) 出典：科学技術白書（昭和56年版）

Key:

(1) Figure 2-3. Changes in the Number of Research-Related Personnel

(2) (10,000)

(3) Number of research-related personnel

(4) Total

(5) Researchers

(6) Research assistants

(7) Skilled laborers

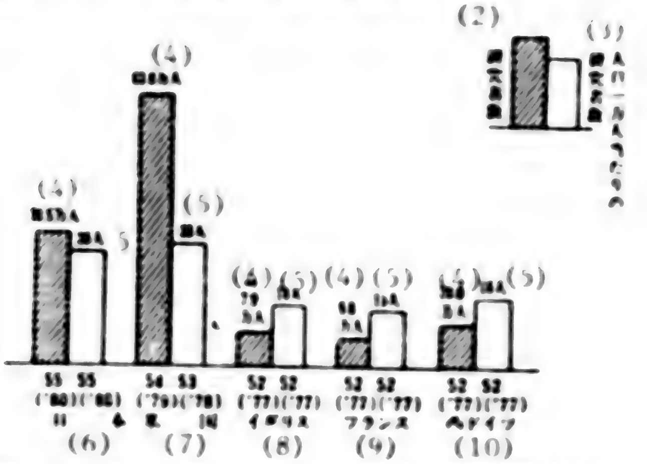
(8) Clerical and others

(9) (Note) As of 1 April for each year

(10) Source: Science and Technology Agency white paper (1981)

(11) Years

(1) 図２－４　主要国の研究者数の比較



(11)注）　1　米国、フランスは人文・社会科学の研究者を含む。

2　米国の研究者数（７９）は推定値。

(12)出典：科学技術白書（昭和５６年版）

Key:

(1) Figure 2-4. Comparison of Number of Researchers by Major Countries
(2) Number of researchers
(3) Number of researchers per 10,000 people
(4) 10,000 people
(5) People
(6) Japan
(7) United States
(8) England
(9) France
(10) West Germany
(11) (Note) 1. United States and France include researchers in humanities and social sciences.
2. Number of researchers of the United States (1977) is estimated.
(12) Source: Science and Technology Agency white paper (1981).

Table 2-[illegible]. Composition Ratio of Major Countries' Researchers by Industries (1977)

(Unit: percent)

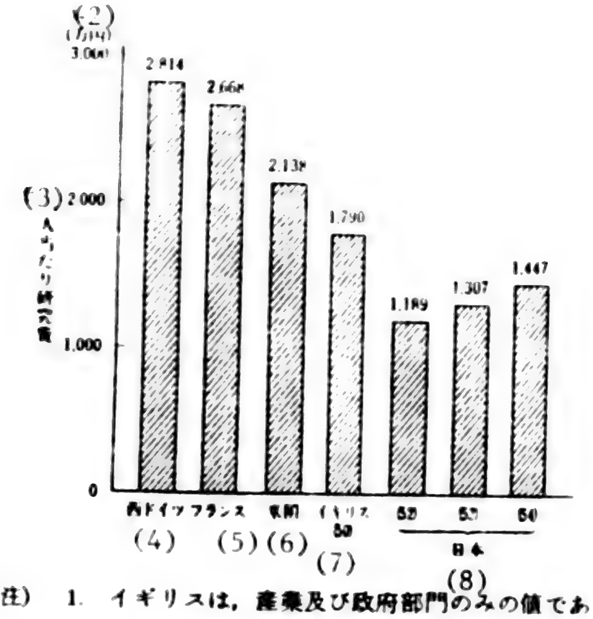
Countries Industries	Japan	United States	(Note) England	West Germany	France
Total industries	100.0	100.0	100.0	100.0	100.0
Manufacturing industries	93.7	96.0	89.6	94.6	92.3
Food industry	3.3	1.7	3.7	0.7	1.6
Textile industry	1.5	0.4	2.2	0.4	1.0
Pulp and paper industry	0.8	1.6	0.8	0.2	0.5
Publications and printing industry	0.3				
Chemical industry	18.7	12.1	18.1	17.4	14.0
Petroleum and coal products industry	0.7	2.3	1.0	0.4	2.7
Rubber products industry	1.5	2.4	0.8	1.1	2.1
Ceramics industry	2.6	1.2	1.8	0.8	1.4
Steel industry	2.7	1.0	2.5	1.2	1.3
Nonferrous metals industry	1.4	1.2	0.8	0.6	0.9
Metal products industry	2.7	1.9	1.0	0.9	1.3
Machinery industry	8.9	4.6	5.5	17.0	4.3
Electric machinery industry	32.7	31.9	24.3	37.7	33.9
Transportation machinery industry	9.0	26.7	23.3	14.0	25.4
Precision machinery industry	3.0	5.3	2.2	2.1	1.5
Other industries	3.8	1.7	1.0	0.1	0.4
Nonmanufacturing industries	6.3	4.0	10.4	5.4	7.7

Data of England are those of 1975.

Japan: Science and Technology Agency white paper
United States, West Germany, France: OECD "International Statistical Year (1977)"
England: OECD "International Statistical Year (1975)"

(1) 図2－5　主要国の研究者1人当たりの研究費の比較

（昭和52年度）



(9)（注）　1.　イギリスは，産業及び政府部門のみの値である。

2　フランスは，人文・社会科学を含む。

(10)出典：科学技術白書（昭和56年版）

Key:

(1)　Figure 2-5.　Comparison of Research Expenditure per Researcher by Major Countries

(2)　(10,000 yen)

(3)　Research expenditure per researcher

(4)　West Germany

(5)　France

(6)　United States

(7)　England (75)

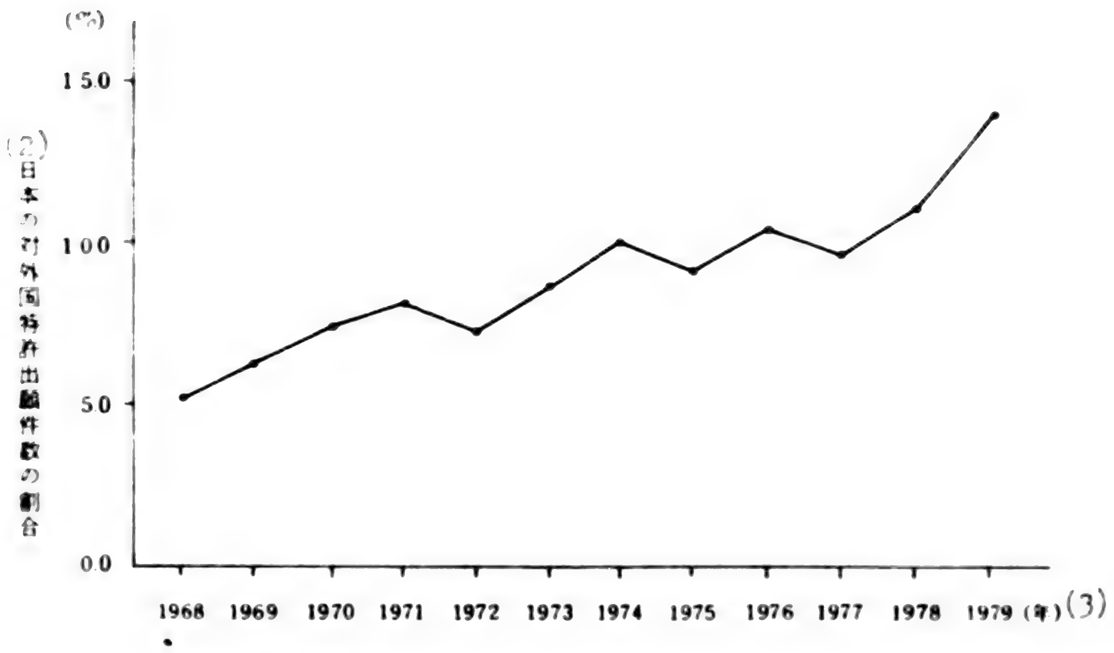
(8)　Japan (77) (78) (79)

(9)　(Note):　1.　Values of England include those of industry and government only.

2.　France includes humanities and social scieces.

(10)　Source:　Science and Technology Agency white paper (1981)

(1) 図２－６　主要２１ケ国の対外国特許出願件数に占める
日本の対外国特許出願件数の割合の推移



(4) 出典：特許庁年報

Key:

(1) Figure 2-6. Changes in the Proportion of the Number of Japan's Foreign Patent Applications to Those by 21 Major Countries

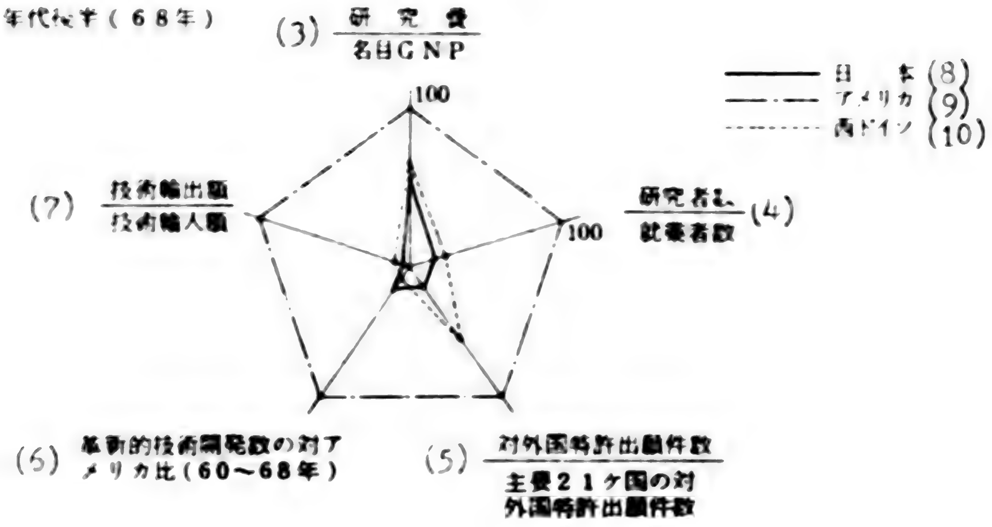
(2) Proportion of the number of Japan's foreign patent applications

(3) (Year)

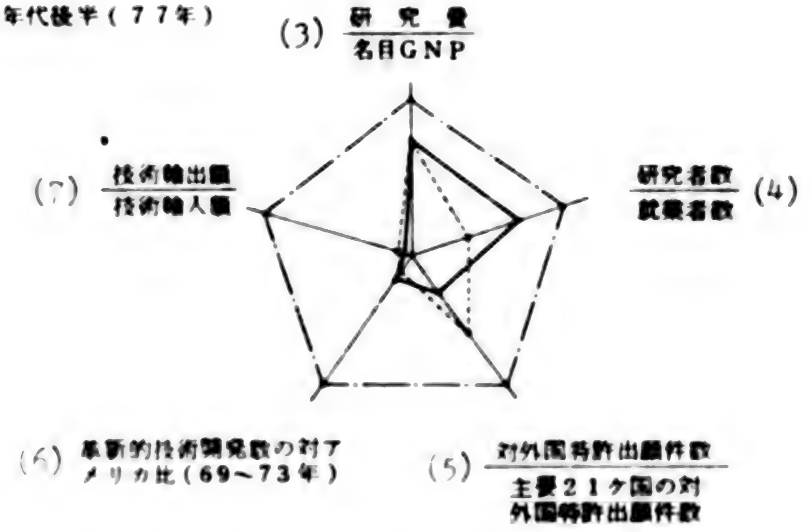
Source: Annual Report of Patent Office

(1) 図２－７　主要国の研究開発力水準

(2) (1) ６０年代後半（６８年）



(11) (2) ７０年代後半（７７年）



(12)（注）　１　アメリカを１００として指数化した。
２　就業者数は製造業における就業者数である。
３　革新的技術開発数は，ゲルマン研究会社調査レポート（１９５３年から１９７３年の間にアメリカ，イギリス，西ドイツ，フランス，日本，カナダにおいて，開発され市場に導入された技術を５００件選定，分析したもの）による。

(13) 出典　：特許庁年報
外国技術導入年次報告
IMF International Finance Statistics
OECD-Maim Economic Indicators
ゲルマン研究会社調査レポート（１９７６年NSF委託）

[Figure 2-7]

(1) Figure 2-7. Major Countries' R&D Standards
(2) (1) Latter half of the 1960's (1968)
(3) Research expenditure/nominal GNP
(4) Number of researchers/number of employees
(5) Number of foreign patent applications/number of foreign patent applications by 21 major countries
(6) Ratio of the number of revolutionary technological developments to the United States (60-68)
(7) Technology exports/technology imports
(8) Japan
(9) United States
(10) West Germany
(11) (2) Latter half of the 1970's (1977)
(12) (Note) 1. Indexes based on United States as 100.
2. Number of employees is the figure in manufacturing industries.
3. Number of revolutionary technology developments is based on German Research Company Survey Report, which selected and analyzed 500 technologies developed and introduced into the markets in the United States, England, West Germany, France, Japan, and Canada between 1953 and 1973.
(13) Sources: Annual report of Patent Office
Annual report on foreign technology imports
IMF-International Finance Statistics
OECD-Main Economic Indicators
German Research Company Survey Report (1976 commissioned by NSF)

Technological Gap Between Japanese and Foreign Companies

(Unit: percent)

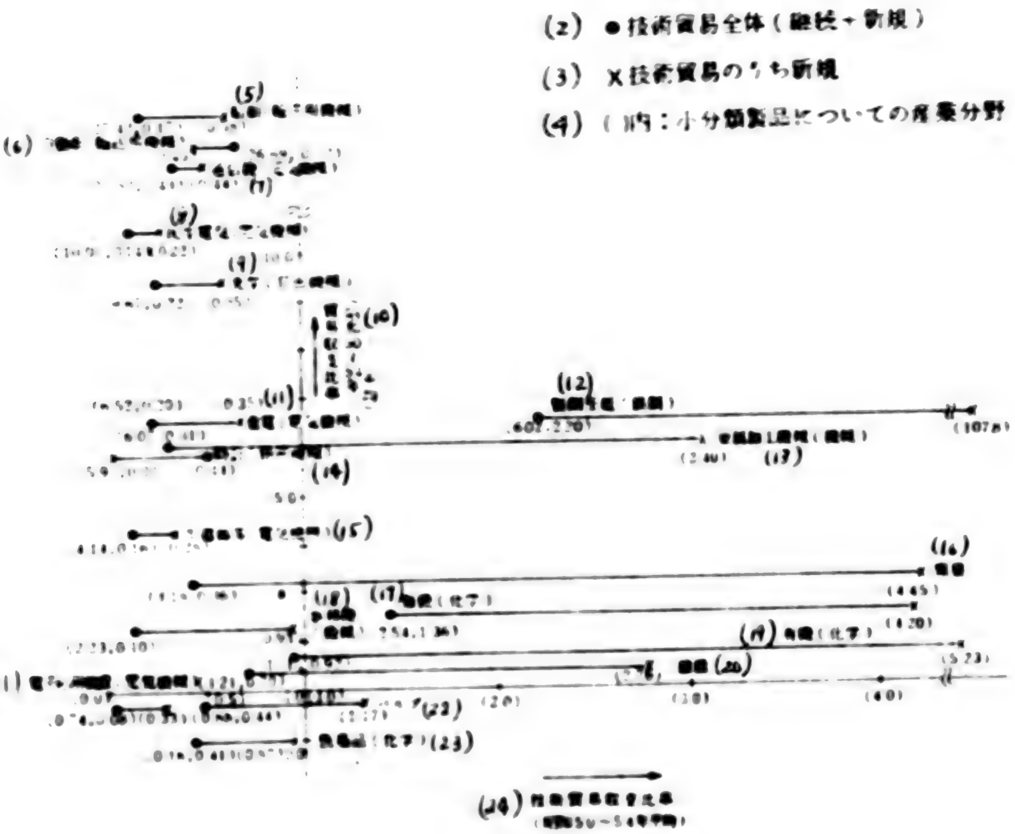
Industries	More advanced than foreign companies	Same as foreign companies	Somewhat behind foreign companies	Behind foreign companies	Total	Number of responding companies
Textiles	22.2	77.8	0	0	100	9
Chemicals	0	78.9	21.1	0	100	19
Ceramics, earth and rocks	50.0	33.3	16.7	0	100	6
Steel	66.7	33.3	0	0	100	12
Nonferrous metal products	33.3	66.7	0	0	100	6
General machinery	13.6	72.7	13.6	0	100	22
Electric machinery	39.0	48.8	12.2	0	100	41
Automobiles	17.6	58.8	23.5	0	100	17
Shipbuilding	500	37.5	12.5	0	100	8
Precision machinery	72.7	27.3	0	0	100	11
[illegible] industries	32.5	55.6	11.9	0	100	151

Percentage = $\frac{\text{Number of companies selected for categories compared}}{\text{Total number of responding companies}}$

Multiple replies

: MITI white paper (1981)

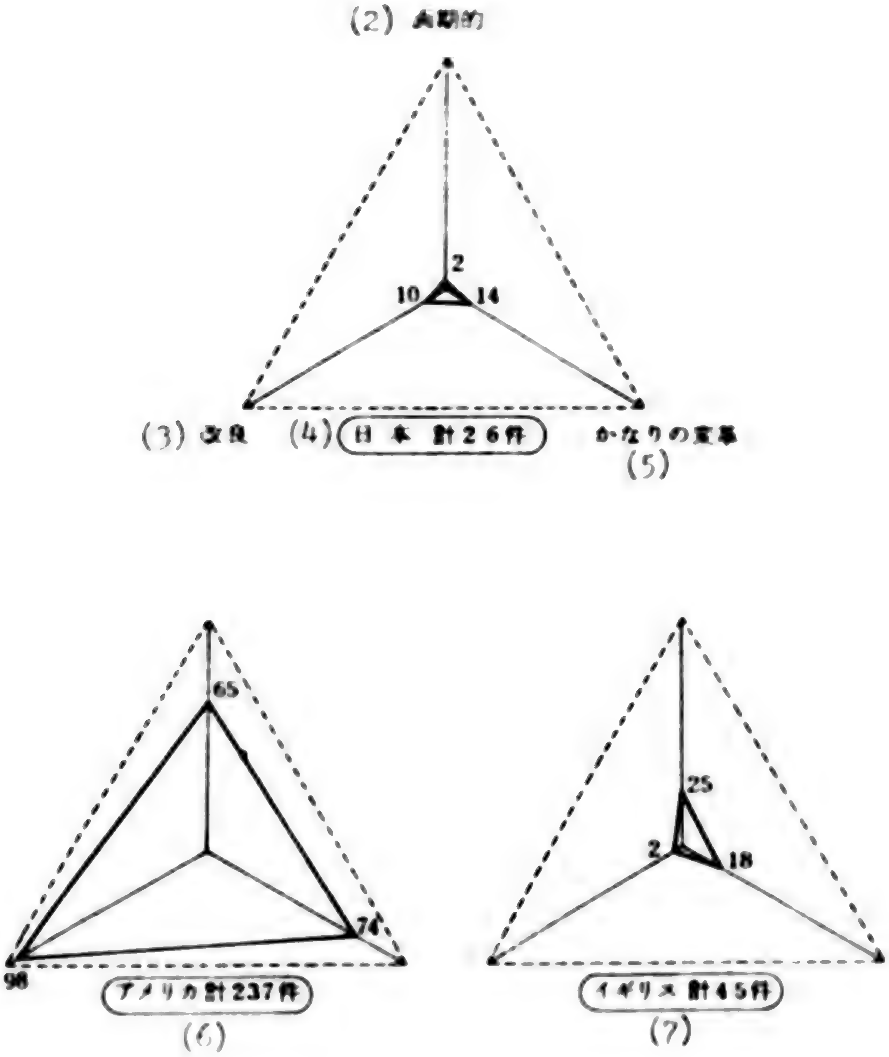
(1) 図2－8　我が国の製品貿易収支と技術貿易収支



[Figure 2-8]

(1) Figure 2-8. Japan's Balance of Products and Technology Trades
(2) Total technology trade (ongoing and new)
(3) New technology trade
(4) ( ) shows general industry category
(5) Ships (transportation machinery)
(6) Automobiles (transportation machinery)
(7) Communications equipment (electric machinery)
(8) Household electric (electric machinery)
(9) Optics (precision machinery)
(10) Balance of trade rate (average of 1975-79)
(11) Heavy electric (electric machinery)
(12) Steel manufacturing and rolling (steel)
(13) Metal processing machinery (machinery)
(14) Watches (precision machinery)
(15) Semiconductors, etc (electric machinery)
(16) Ceramics
(17) Inorganic (chemical)
(18) Office machines (machinery)
(19) Organic (chemical)
(20) Textiles
(21) Applied electronics equipment (electric machinery)
(22) Pulp
(23) Pharmaceuticals (chemical)
(24) Balance of technology trade rate (average of 1975-79)

(1) 図2－9　主要国の技術の革新度



(8) (注)　　図2－7の(注)3に同じ

(9) 出典　：　ゲルマン研究会社調査レポート（1976年NSF委託）

Key:
(1) Figure 2-9. Degree of Technological Innovations of Major Countries
(2) Revolutionary
(3) Improved
(4) Japan total: 26 cases
(5) Significant change
(6) United States total: 237 cases
(7) England total: 45 cases
(8) (Note) Same as (Note) 3 of Figure 2-7
(9) Source: German Research Co Survey report (1976 commissioned by NSF)

Specifically, the status of the balance of major products trade (average of [illegible]) (Figure 2-8) shows a surplus in steel, ceramics, precision machinery and electric machinery, indicating the strength in the international competitive power of those products.

However, the balance of technology trade, which is considered to be one of the indexes for technological standards, unexpectedly reveals a weak point in the technological foundation which supports these industries (Figure 2-8). In other words, unlike the products trade, the balance of technology trade, with the exception of the iron and steel industry, shows an excess of imports. We must give particular attention to low rates in the balance of technology trade in the areas of semiconductors and electronics parts (the ratio of the balance of technology trade, 0.16), applied electronics equipment (0.08 of the same), and communications equipment (0.43 of the same) which are intensive-research-oriented industries (recently referred to as high technology industries) and insure that they have stronger international competitive power.

The technological standards shown by the balance of products trade mainly represent the standards of cost-oriented production technology such as reduction of manufacturing cost by mass production, automation, quality control, etc, whereas the technological standards indicated by the balance of technology trade mainly express the basic technologies which concern patents.

Accordingly, in spite of the excess of exports in the products trade, the excess of imports in the balance of technology trade indicates that Japan's technological standards have not reached those of foreign countries in the field of basic technology, although the reason for this lies partially in the fact that the basic patents for semiconductors and computers are held by foreign manufacturers.

In addition, concerning technology trade under new contracts (Figure 2-8), the balance of trade is generally improving, and as mentioned above the percentage of the number of foreign patent applications by the Japanese is also increasing (Figure 2-6). Therefore, the trend of independent technologies or technological inventions is on a gradual rise; however, as seen in the [illegible] report compiled by the German Research Company (1976 survey commissioned by the American National Science Foundation) (Figure 2-9), Japan does [illegible] contribute to the remarkable technological innovations, and one of [illegible] for this seems to be the small amount of investment for basic

[illegible]. Directions of R&D

[illegible] with the status of R&D in Japan and its technological standards [illegible] in the previous chapter, in this chapter we would like to discuss the directions of R&D from two points of view: expectations from tech[illegible] directions of technology.

[illegible] from Technology

[illegible] in the postwar period, it achieved high economic growth, and accomplished a smooth transition toward stable growth since the oil crisis. Today, it has become a great economic nation, accounting for approximately 10 percent of the world economy (GNP).

However, we must solve many problems while meeting such diversified and sophisticated national needs as stabilizing the standard of living and creating communities within Japan. On the other hand, we must deal with severe international conditions such as trade friction and the energy situation outside Japan.

Because of this, the Industrial Structure Council Report entitled "The Way of 1980's Trade and Industry Policy" (March 1980) lists the following three national goals for both the 1980's and 1990's:

1) International contribution from the standpoint of a "great economic nation"
2) Overcoming of the restrictions of a "small resources nation"
3) Compatibility of "vitality" and "comfort"

In order to accomplish these three national goals, the expectations from technology are extremely great. Since our lifestyle has been dramatically changing, it is expected that technology will be a motivating force which will develop industries. Furthermore, by means of outstanding development through "mechatronics" technology, technology is expected to create the potentiality of a new culture. Based on this basic awareness, this research committee considered three expectations from technology, namely, a "mechanization of human functions," an "overcoming of resource and energy restrictions," and an "expansion into space and ocean."

1) Mechanization of Human Functions

From the use of tools, fire, and stoneware by human beings to the present use of plastics and electronics, technology has been a familiar means to realization of the dreams and desires of mankind. The "mechanization of human functions" expressed here means an attempt to make technology more useful than ever so as to solve the various problems of human beings. In other words, technology means not only those production tools for replacing human activities as seen in industrial robots, office automation, and artificial intelligence and for liberating humans from monotonous or high-risk labor, but it also means those technologies which are aimed at the recovery and replacement of the functions of the human body by medical equipment such as an artificial heart. In addition, in most fundamental areas, the elucidations of life phenomena or biological functions also have the potential to become new seeds for future technological innovations. The technology to meet these expectations needs to be developed with sufficient consideration given to the internal needs of mankind, such as human nature and emotion. As a result of this, technology will bring "vitality" and "comfort" to our society (Table 3-1).

2) Overcoming of Restrictions on Resource and Energy

Overcoming restrictions on resources and energy is indispensable in terms of national security for Japan, a "small resources nation," and at the same time, we must deal with this as a world issue in terms of our international responsibility from the standpoint of a "great economic nation."

(1) 表３－１　オフィスオートメーションの流れ

(2) オフィスオートメーションの芽生え →	(3) データプロセッシング主導の時代 →	(4) 分散処理の芽生え	(5) → 現代のオフィスオートメーション →	(6) 未来のオフィスオートメーション
(7) 伝統的な事務管理の時代 （ex. カナタイプ 複写機 計算機 etc）	(8) 集中処理全盛の時代 （ex. 汎用コンピュータの活用）	(9) 分散処理の時代 （ex. ミニコン オフコン マイコン etc）	(10) 新しい事務管理の時代 （ex. 自動翻訳機 自然言語処理システム 人工知能　etc.）	⇨ 人間性の回復 (11)
1950年代 (12)	1960年代 (13)	1970年代 (14)	1980年代 (15)	1990年代～2000年代 (16)

Key:

(1) Table 3-1. History of Office Automation
(2) Emergence of office automation
(3) Age of data processing
(4) Emergence of divergent processing
(5) Present office automation
(6) Future office automation
(7) Age of traditional office control
(e.g., Japanese alphabet typewriter, copy machine, calculator, etc)
(8) Golden age of concentrated processing
(e.g., all-purpose computer)
(9) Age of divergent processing
(e.g., minicomputer, office computer, microcomputer, etc)
(10) Age of new office control
(e.g., automatic translating machine, natural language processing system, artificial intelligence, etc)
(11) Recovery of humanness

For this reason, we must develop energy-related technology as an alternative to oil, through nuclear power, coal, and solar energy. Technology must be developed to conserve energy through the use of the fuel battery and bioreactor, through biotechnology, or through new equipment, new materials, and mining. It is also necessary to develop the technology for natural resources such as oil and metals, and to develop technology utilizing industrial raw materials, foods, or energy, as represented by biomass.

3) Expansion into Space and Ocean

Technology has expanded the limits of human activity in the past. For example, airplanes directed the human eye toward the sky and liberated human beings from their restriction to earth. The utilization of space broadened activity through international communications, meteorological observations and the investigation of resources by satellite. A space plant would bring about such conveniences as rapid information transmission, an increase in information storage, and production of new materials which cannot be obtained on earth.

Also, unexplored areas still exist in the ocean, which covers three-fourths of the earth. For example, the search for and digging for oil, the major source of our present energy supply, has expanded from the earth to the continental shelf and deeper, to the slope of the continental shelf. Furthermore, the areas of utilization and activity have been expanded to the search for and collection of manganese nodules, a new source of supply of metal resources, going deeper into the bottom of the ocean (Figure 3-1).

Accordingly, we expect technology to expand into space and ocean in the same way as a planetary rocket explores the reaches of outer space, so that the area which mankind can reach in the future will be widened and thereby provide new choices for mankind. We believe that our challenge to widen the frontier of mankind will not only lead to an international contribution but will also bring "vitality" and "comfort" to our society.

Directions of Technology

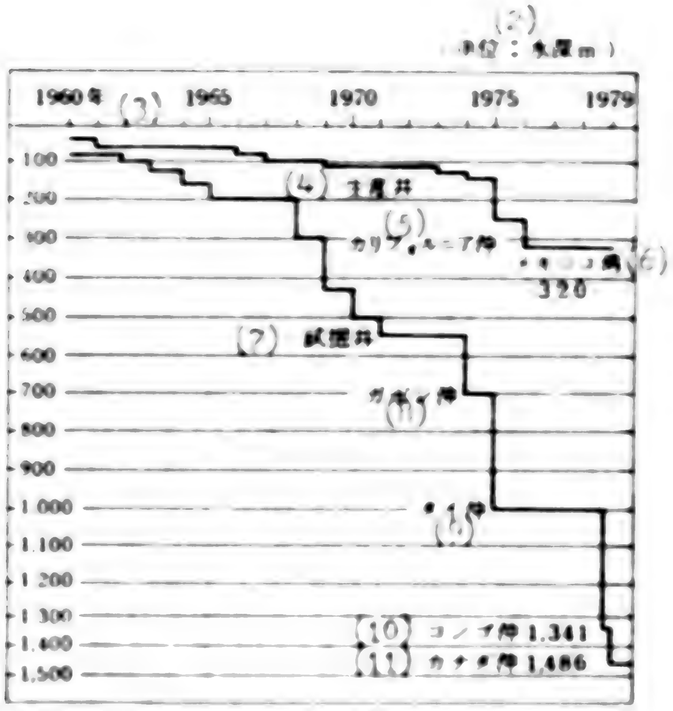
(1) Significance of Basic Technologies

In order to meet the expectations for technology discussed above, this research committee has selected and examined 365 priority R&D issues among those to be solved by the 21st century.

In our interim report (August 1980), the committee took up essential technologies such as "basic technologies," "machinery and equipment technologies," and "system technologies" which make up these priority R&D issues and pointed out the significance of basic technologies (biotechnology, new materials, new function elements, etc.) in particular, from the following points of view:

(1) Since basic technologies are at the stage of fundamental development, the risk involved in development is great.

(1) 図３－１　沖合油田における掘削水深記録



(12)出典：通商産業省所有資料より。

(1) Figure 3-1. Record of Drilling Depths of Offshore Oil Fields
(2) (Unit: depth in meters)
(3) [illegible]
(4) Production wells
(5) Offshore, California
[illegible]
[illegible]
(8) Offshore, Gabon
(9) Offshore, Thailand
[illegible]
[illegible]
(12) [illegible] International Trade and Industry data

[illegible] basic technologies have a common basis, their developmental re-[illegible] an impact on a wide range of R&D.

[illegible] Basic technologies are the area which every advanced country has an eye [illegible] so there is an international competition to take the initiative.

[illegible] Japan has been depending on foreign countries for a great deal of basic [illegible]; however, the climate is such that it will not allow Japan to [illegible] these technologies easily in the future.

[illegible] of the significance of these basic technologies, in FY-81 the Agency [illegible] Industrial Science and Technology established the "Next Generation Basic Industrial Technology R&D System," and through utilizing the research activ[illegible] of the private sector, began to develop technologies which will become [illegible] foundation of industries after the 1990's.

[illegible] Directions of Technology

[illegible] report, based upon the contents of the interim report and the further [illegible] of priority R&D issues, we would like to propose three directions [illegible] technologies: "microtechnology," "information technology," and "[illegible] technology."

[illegible] Microtechnology

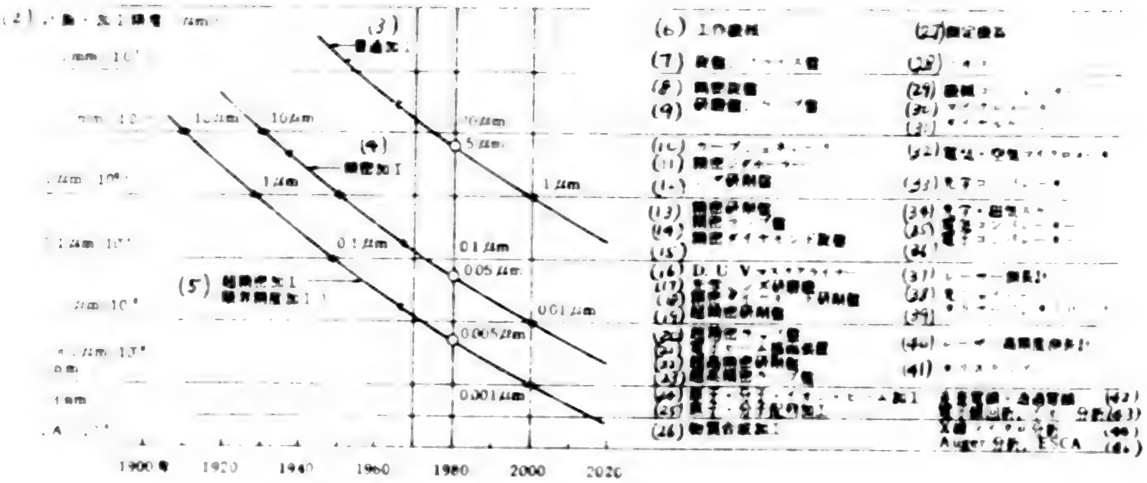
[illegible] area represented by the so-called basic technologies, the development [illegible] manufacturing, processing, measuring, or substance operations at the micro [illegible] regard to fineness, minuteness, and high density, has a core function [illegible] technological progress. For example, in manufacturing and processing [illegible], the precision level of measurement has been upgraded to accommo[illegible] minute size of an atom, as seen in the production of super LSI, [illegible] expanding technological potential. Also, the operation of genes as [illegible] biotechnology is becoming a major factor in process conversion, such [illegible] application of biological functions to chemical processes by means of [illegible] applying genes in the micro world to technology (Tables 3-2, 3-3).

[illegible] Information Technology

[illegible] term "information society" was created, information has gained [illegible], and the so-called information technology, which deals with [illegible] processing, has been undergoing rapid progress.

[illegible] computer technology has accomplished remarkable progress by [illegible] operating speed and larger memory capacity in order to [illegible] volume of information accurately and speedily, which is the [illegible] computer (Figures 3-2, 3-3). Along with the process in sensor [illegible] technologies, computers are about to evolve from simple computa-[illegible] more sophisticated information processing machines. [illegible] of replacing the functions of five human senses as seen [illegible], that is, recognition of character and voice, and per-[illegible] human thinking and judgment as seen in artificial [illegible] that of human beings.

(1) 表3－2　原子の大きさのレベルにまで精度が上がってきた精密・計測加工



(46) 出典：工作機械関連技術者会議　資料

Key:

(1) Table 3-2. The Precision Level of Precision and Measuring Manufacturing Has Been Upgraded to the Size of an Atom
(2) Precision level of measuring and manufacturing (μm)
(3) Ordinary manufacturing
(4) Precision manufacturing
(5) Super precision manufacturing (limit of precision manufacturing)
(6) Machine tool
(7) Lathe, milling machine
(8) Precision lathe
(9) Grinder, lapping machine
(10) Gear generator
(11) Precision jig borer
(12) Jig grinder
(13) Precision grinder
(14) Precision lapping machine
(15) Precision diamond lathe
(16) D.U.V. mask aligner
(17) Optical lens grinder
(18) Precision diamond grinder
(19) Super precision grinder
(20) Super precision lapping machine
(21) Electronic beam drawing equipment
(22) Super precision grinder
(23) Super high precision grinder

[key continued]

[Continuation of Key to Table 3-2]

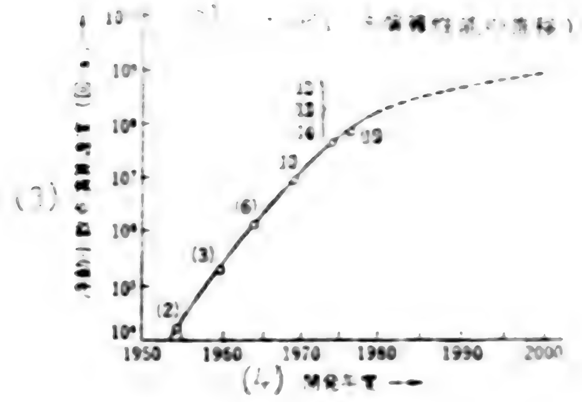
Atom, particle, ion, and beam manufacturing
Atom and particle configuration manufacturing
Substance composition manufacturing
Measuring equipment
Slide caliper
Machine converter
Micrometer
Dial gauge
Electric and air micrometer
Optical converter
Optical and magnetic scale
Electric converter
Electronic converter
Laser length measuring apparatus
Optical fiber
Tallysurf [phonetic], tallyrondo [phonetic]
High precision laser measuring apparatus
Tallystep [phonetic]
Scanning electron microscope and transmission electron microscope
Electronic wire diffraction, ion analysis
X-ray microanalysis
Auger analysis, ESCA
Source: "Machine Tools Engineers Conference" material

表３－３　バイオテクノロジーにみられる微小化

(1) 技術の対象	(3) 個体（動物，植物 微生物）	(4) 細　胞	(5) 遺　伝　子
(6) [illegible]	(7) 数m～1×10^{-4} m	17×10^{-5} m	2×10^{-9} m
(8) 研究開始時期	(9) 農業開始以来	(10) １９５０年代～	(11) １９７３年～
(12) 技術内容	交配，醗酵 (13) （品種改良，抗生物質，醗酵食品）	細胞融合，組織培養 (14) （インターフェロン，血清，ポマト）	遺伝子組換え技術 （インターフェロン，インシュリン，成長ホルモン） (15)

(1) Table 3-3. Minuteness in Biotechnology
(2) Objectives of technology
(3) Population (animal, vegetation, microorganism)
(4) Cell
[illegible]
Scale
Several meters
[illegible] research began
Since agriculture began
[illegible] on
[illegible] on
Contents of technology
[illegible], fermentation (improvement of breed, antibiotics, fermented
[illegible]
[illegible], tissue culture (interferon, serum, pomato)
[illegible] technology (interferon, insulin, growth hormone)

(1) 図3－2　コンピュータにおける情報処理の高速化



真空管
(1) IBM 650
(2) IBM 704

トランジスタ（含むハイブリッド）
(3) IBM 7090
(4) IBM 7094
(5) IBM S/360/50
(6) CDC 6600

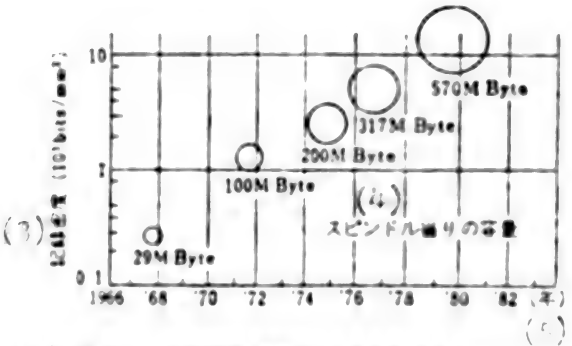
(7) 集積回路(IC)
(7) IBM S/360/50
(8) CDC 6600
(9) IBM S/360/91
(10) CDC 7600
(11) IBM S/370/195

(7) 集積回路(MSI/LSI)
(12) TI ASC
(13) ILLIAC Ⅳ
(14) CDC STAR
(15) CRAY Ⅰ
(16) BSP

出典：電子通信学会誌（1979.11）

(1) 図3－3　情報記憶への要求

(2)（磁気ディスク装置の記録密度とスピンドル当りの容量の推移）



出典　電子通信学会誌（1979.11）

[Figure 3-2]

Figure 3-2. High-speed Information Processing in Computers
Floating decimal point computing speed (revolution/s)
Development year
Vacuum tube
Transistor (including hybrid)
Integrated circuit (IC)
Source: Institute of electronics and Communication Engineers of Japan Journal (November 1979)

[Figure 3-3]

Figure 3-3. Demands for Information Memory
Trends in memory density of magnetic disc device and capacity per spindle
Memory density
Capacity per spindle
[illegible]
Source: Institute of Electronics and Communication Engineers of Japan Journal (November 1979)

[illegible] Although [illegible] and telephone [illegible] society today, and our [illegible] of information [illegible] is strong. [illegible]

[illegible] communications and [illegible] information [illegible] the area of information itself. [illegible]

[illegible]

[illegible] Particularly in terms of the number of parts, [illegible] has been achieved. [illegible] "mechatronics," as represented by industrial robots and [illegible] technologies are unified. [illegible] Also, computers [illegible] supported by progress in semiconductor technology, are in [illegible] performance and multiple [illegible]

[illegible] major [illegible] electronics [illegible] will be further accelerated [illegible]

[illegible] i.e., "microtechnol[illegible]" and "compensation[illegible]" the future of [illegible] the directions of [illegible] from technologies. [illegible] expectations from technologies, i.e., [illegible] resources and energy [illegible] and information [illegible], and [illegible] supported [illegible]

[illegible]

[illegible] [illegible] period, the direction [illegible]

[illegible] expectations from technolo[illegible] of human functions," "[illegible] of resources and energy [illegible] the direction of [illegible] "intelligence," and "[illegible] [illegible]

(1)図３－４　情報伝送（通信）の容量推移

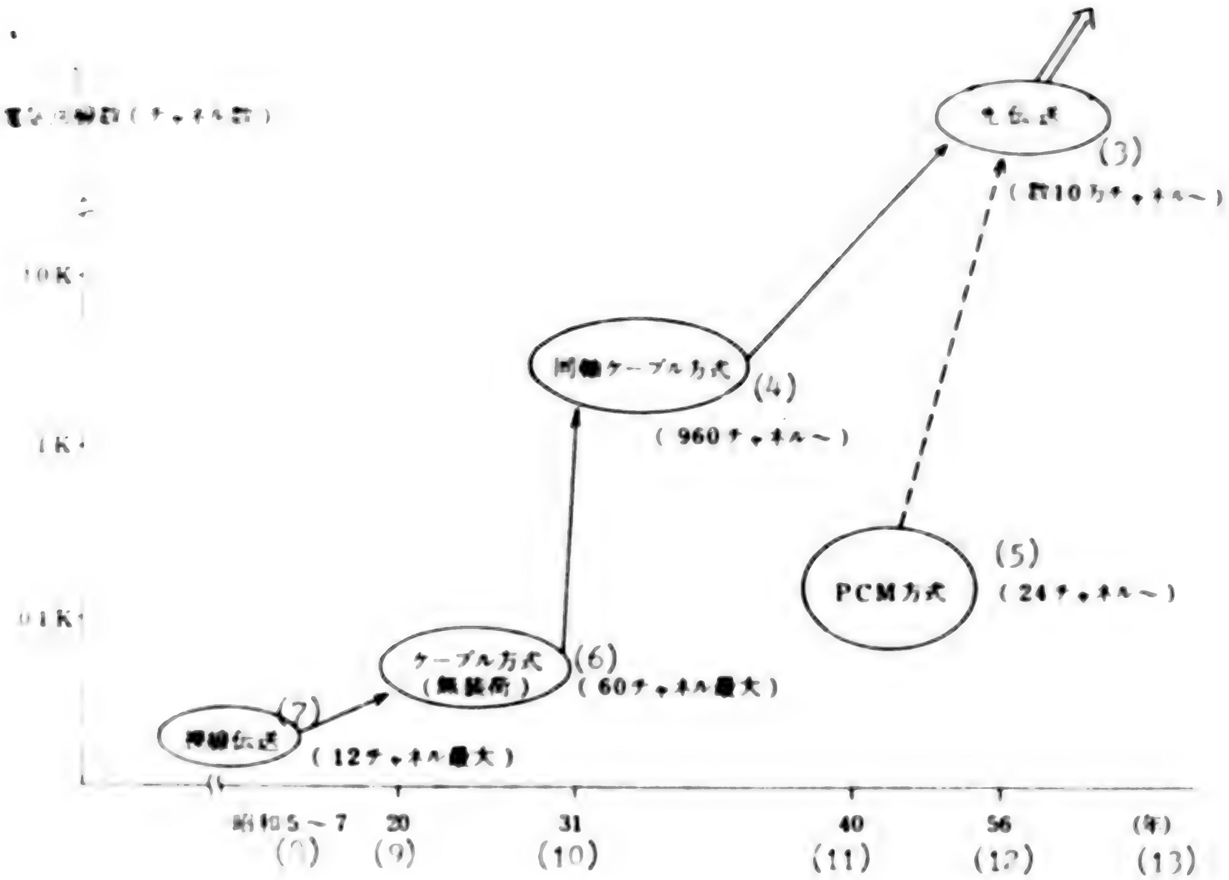
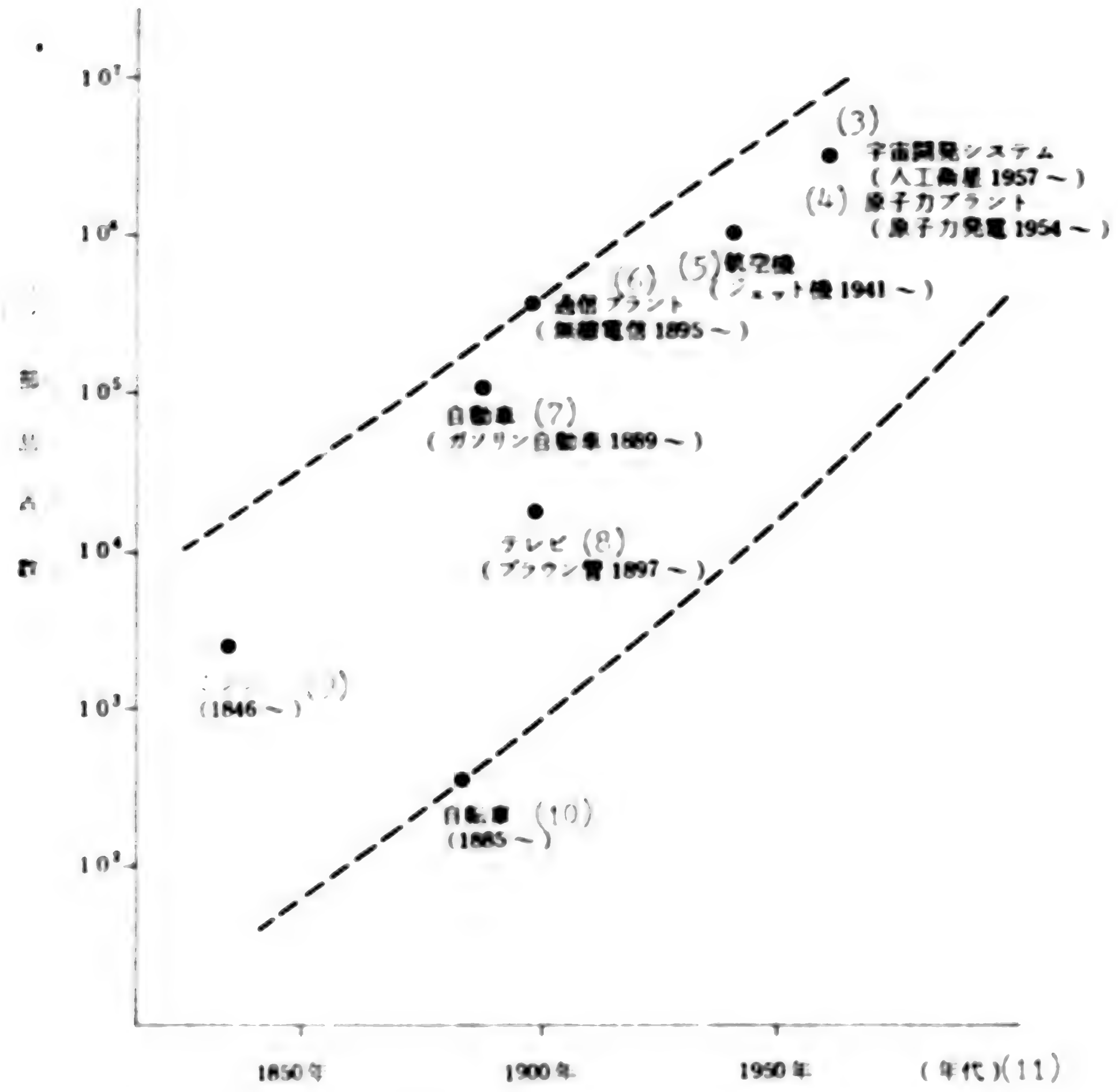


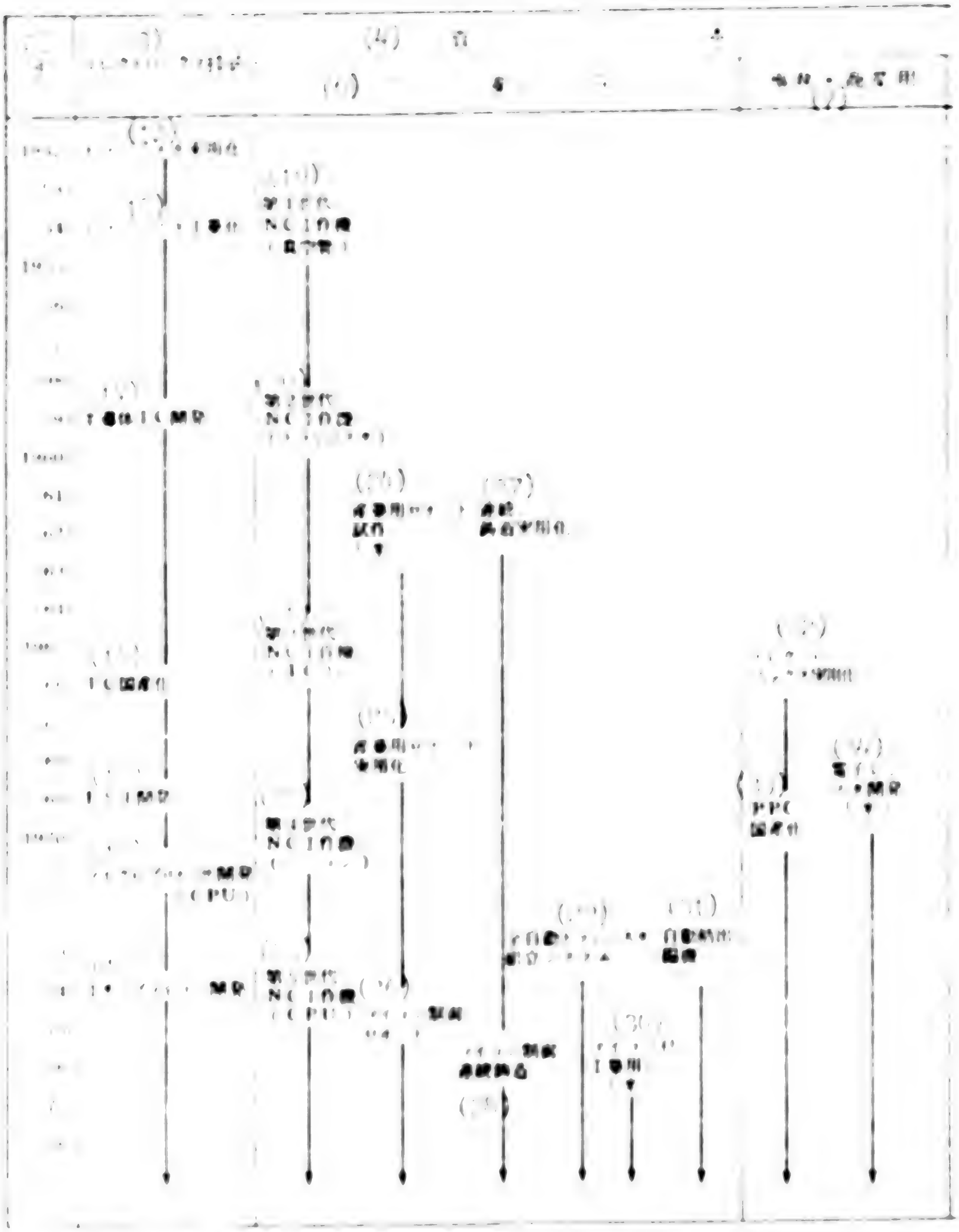
Figure 3-4. Changes in Capacity of Information Transmission (Communications)
Number of telephone circuits (number of channels)
Optical transmission (more than 100,000 channels -)
Coaxial cable method (960 channels)
PCM method (24 channels -)
Cable method (unloaded) (maximum 60 channels)
Open wire transmission (maximum 12 channels)

(1) 図3-5　複合化の進展 — 部品点数から



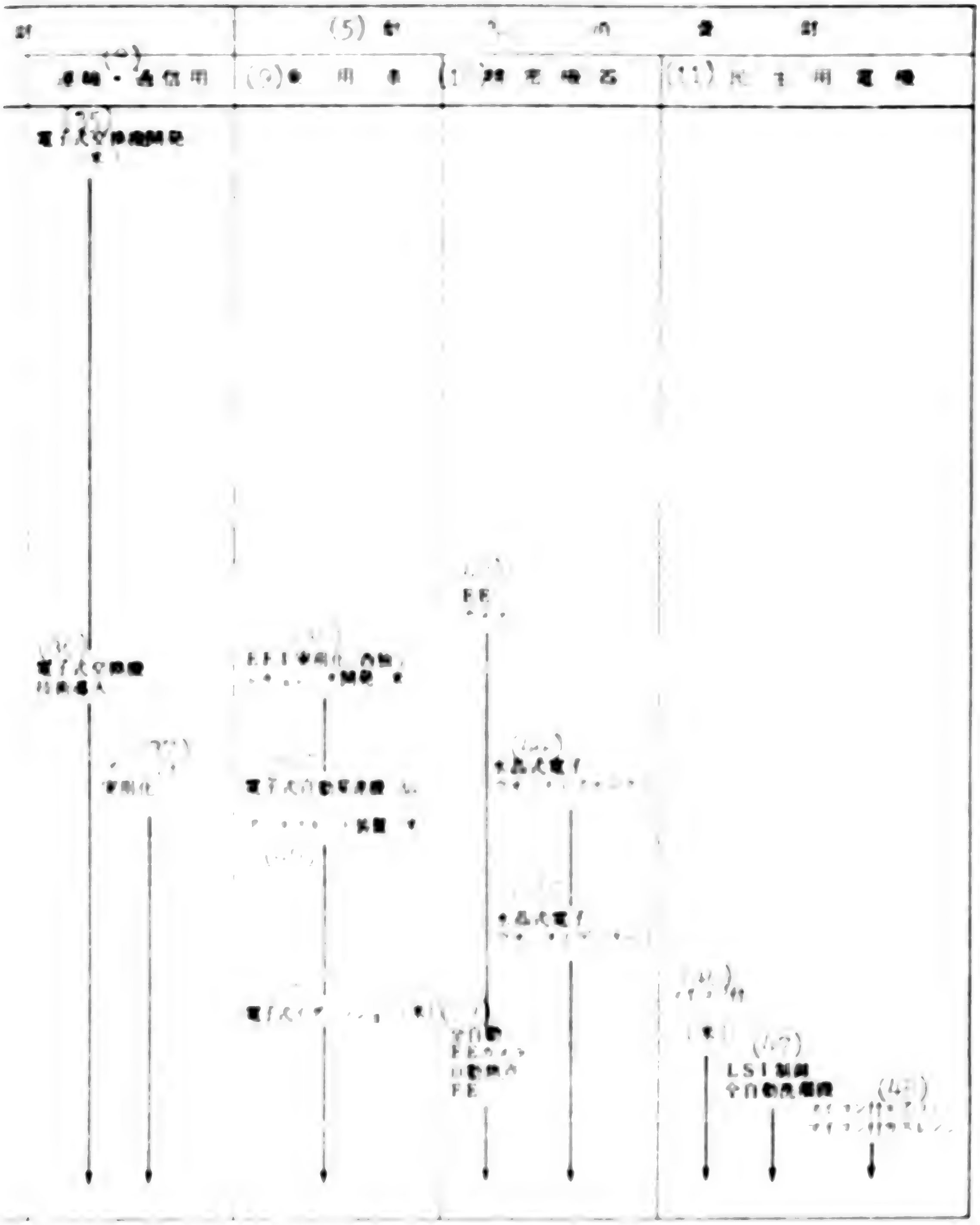
Source: Yuji Masuda, "Advanced Technology Industries," Toyo Keizai Shimposha
S. Lilly [phonetic] "History of Mankind and Machines," Iwanami Shoten Hoshimi Uchida, "Introduction to the History of Industrial Technology," NIHON KEIZAI SHIMBUNSHA

Key:
(1) Figure 3-5. Progress Toward Compound Usage--Based on Number of Parts
(2) [Number of parts]
(3) Space Development System (satellite: 1957 -)
(4) Nuclear power plant (nuclear power generation: 1954 -)
(5) Aircraft (jet: 1941 -)
(6) Communications plant (wireless telegraph: 1895 -)
(7) Automobile (gasoline car: 1889 -)
(8) Television (picture tube: 1897 -)
(9) Sewing machine (1846 -)
(10) Bicycle (1885 -)
(11) (Generation)



[illegible] 機械産業の発展に関する調査研究 機械振興協会 [illegible]

[illegible]発展年表



[[illegible] follows]

[illegible] Table of the Development of Mechatronics

[illegible]

[illegible] NC machine tool (NC generation)

[illegible] machine tool [illegible]

[illegible] generation NC machine tool [illegible]

[illegible] generation NC machine tool (mini computer)

[illegible] generation NC machine tool [illegible]

[illegible] development of industrial robot (first stage)

[illegible]

[illegible] assembly [illegible]

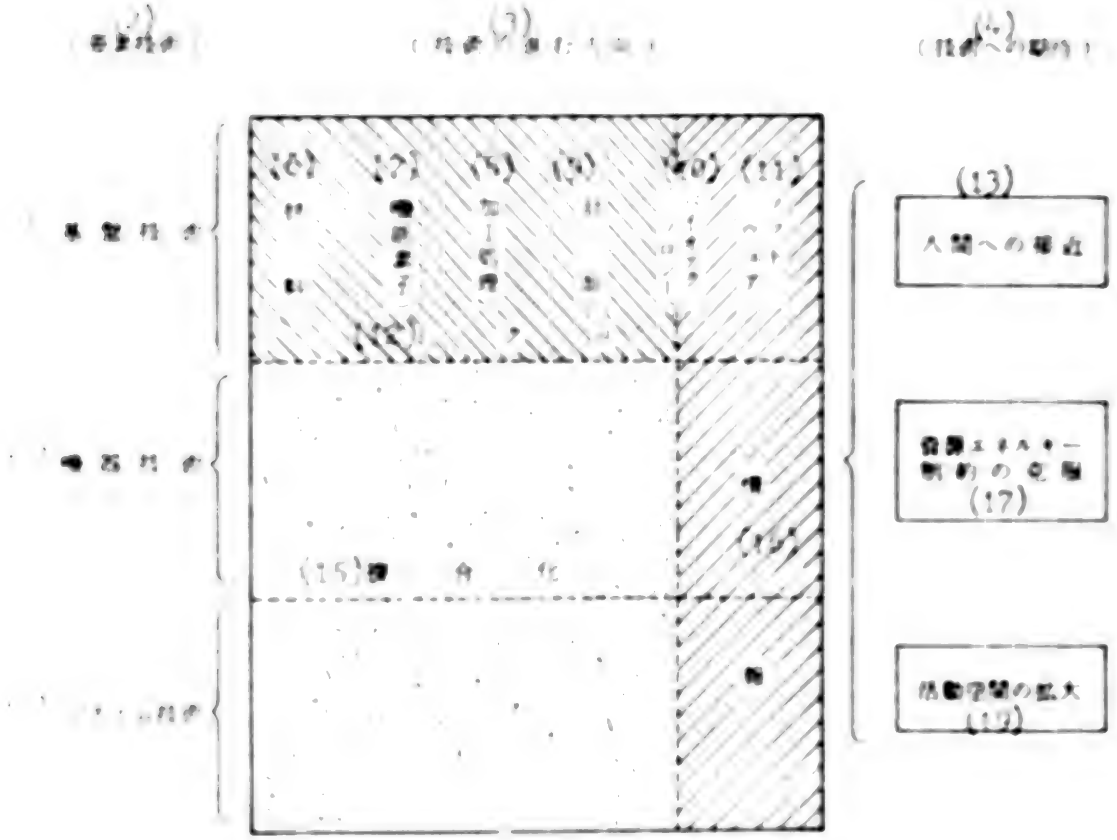
[illegible] industrial robot [illegible] with micro computer [illegible] stage

[illegible]

[illegible] Electronic Industry [illegible]

[illegible] Promotion Association [illegible]

(1) 図3 [illegible] 技術の動向と技術の進む方向



[illegible]

(10) (Biotechnology)
(11) (Software)
(12) Micro
(13) Mechanization of human functions
(14) Machinery and equipment [illegible]
(15) Compound use
(16) Information
(17) Conquest of resources and energy restrictions
(18) System [illegible]
(19) Expansion into space and ocean

[illegible] represented [illegible] important [illegible] will [illegible] important effects [illegible] future [illegible]

[illegible] in the future [illegible] independent technology [illegible]

[illegible] it is necessary to [illegible] commercialize the results. Therefore, there will [illegible] long-term period of research.

[illegible] resulting from such research must contribute not only to [illegible] but also to the [illegible] of the world economy. In order [illegible] must be promoted in such a way that its results will [illegible] international industrial property rights, [illegible] with the advanced western industrial countries [illegible] based on international industrial property

[illegible]

[illegible]

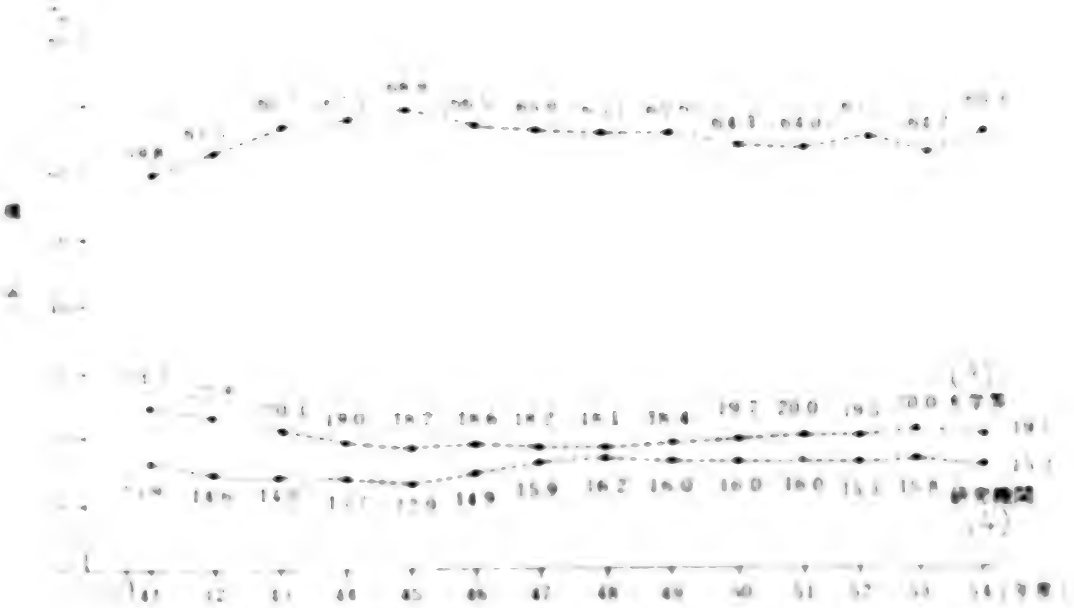
[illegible]

[illegible]

[illegible]

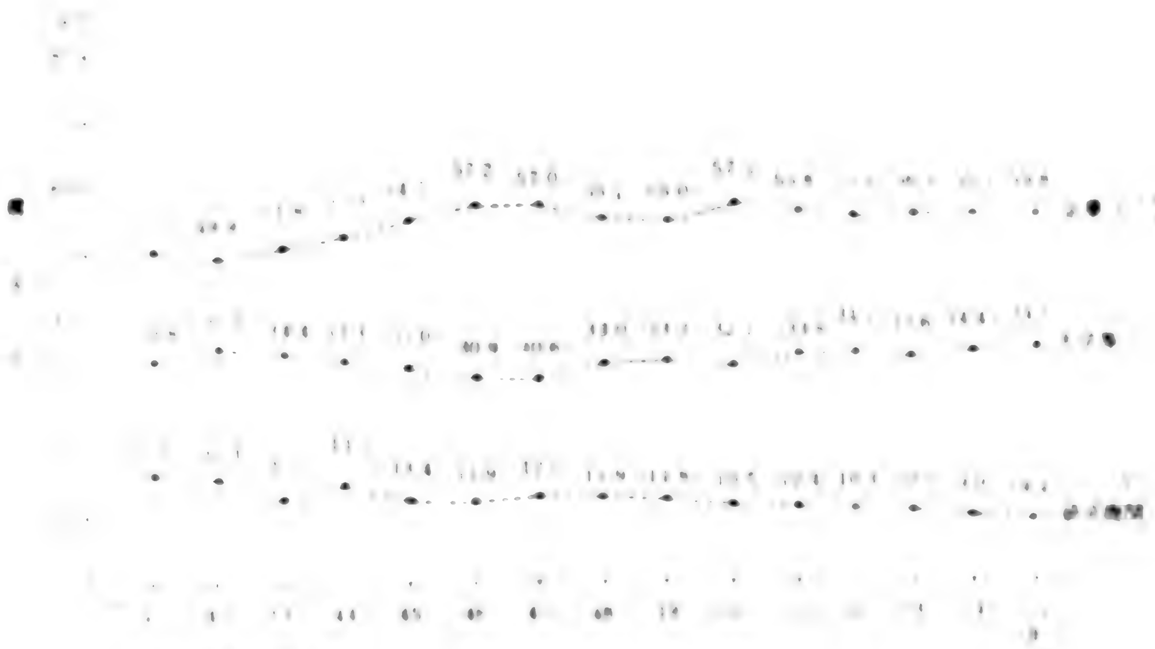
[illegible]

我が国の主体別研究費（構成比）の推移



出典 総理府統計局「科学技術研究調査報告」、「科学技術研究調査結果の概要」

我が国の主体別研究者数（構成比）の推移

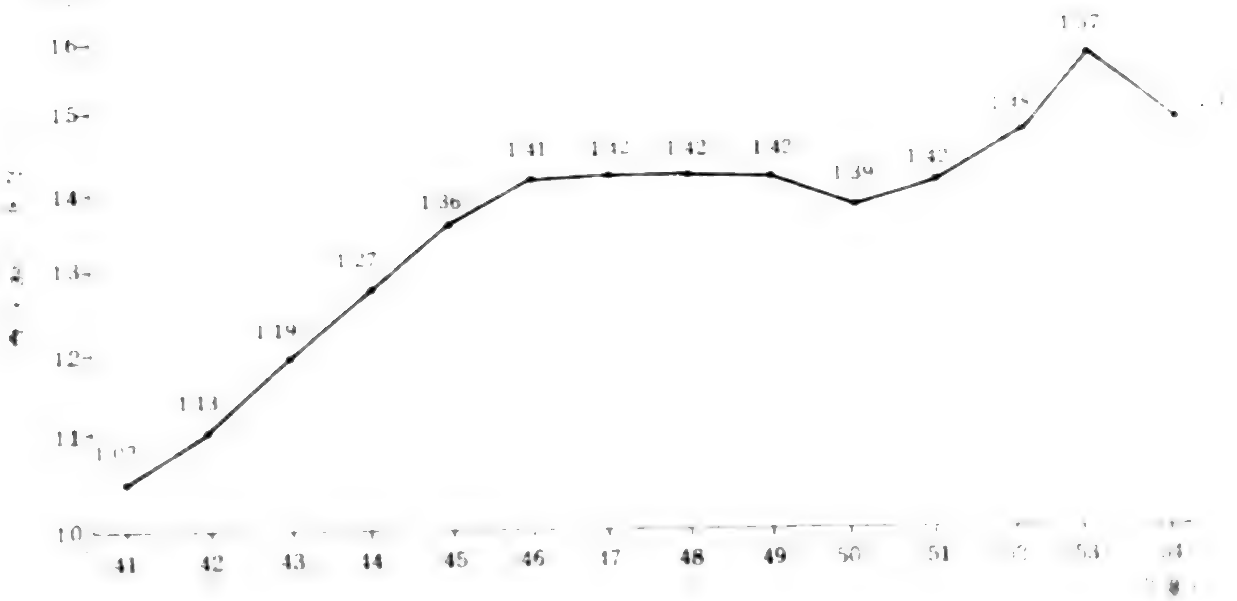


出典 [illegible]

[illegible]

[illegible] Japan's [illegible] Expenditure (Composition Rate)
[illegible] and Research Agencies.
[illegible]
[illegible]
[illegible]
[illegible] (Fiscal Year)
[illegible] Survey Report; Summary
[illegible] and Scientific Technical Research Survey

第1－3図　わが国企業の研究費の対売上高比率の推移



（注）比率は研究費を売上高で除したもので、特殊法人は含まない。

（資料）４２年～５４年科学技術研究調査報告、５５年科学技術研究調査結果の概要

[illegible] 1-3. Changes in the Proportion of Research Expenditure to [illegible] Companies—Private Sector

[illegible] research expenditure to sales

[illegible] 70, 71, 72, 73, 74, 75, 76, 77, 78, [illegible]

[illegible] of research expenditure to [illegible] research expenditure [illegible] sales; [illegible] are excluded.

[illegible] Scientific Technology Research Survey; [illegible] Results of 1980 Scientific Technology Survey

[illegible] Proportion of Major Countries' Research Expenditure to Sales [illegible] Industries

(Unit: percent)

Countries (unit, fiscal year) Industry	1977 Japan	1977 United States	1975 West Germany
All industries	1.[illegible]	3.1	2.8
[illegible]	[illegible]	0.4	0.[illegible]
[illegible] (including synthetic fibers)	[illegible].6	0.4	1.0
[illegible]	2.[illegible]	3.6	4.8
[illegible]	[illegible].8	6.[illegible]	
[illegible]	2.0	2.[illegible]	--
[illegible]	[illegible]	1.2	1.3
[illegible]	1.1	0.6	0.4
[illegible]	1.0	1.1	--
[illegible]	1.[illegible]	1.2	--
[illegible]	2.[illegible]	[illegible].0	3.1
[illegible]	3.[illegible]	6.3	6.1
[illegible]	2.3	3.1	2.9
[illegible]	2.9	6.1	4.5

[illegible] research expenditure to sales is obtained by dividing [illegible] by sales.

[illegible] Technology Research [illegible] report NSF, "Research and [illegible] in Industry 1977 (NSF 79-313)"

[illegible] Foundation, "Wirtschaft und Wissenshaft [illegible]"

[illegible]

(Average of 1963-73)

[illegible]	Japan	United States	England	West Germany	France
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.3

[illegible]

[illegible] (average [illegible] of Japan's [illegible] other countries is 6-8 years, Japan's is a short [illegible], of about half. It is assumed that Japan's R&D activities [illegible] the [illegible] stage based on imported technologies such as [illegible].

[illegible], since the proportion of the private sector's R&D investment [illegible] stages indicates a trend of decline in basic research expenditure, [illegible] uncertainty regarding Japan's technological innovation [illegible].

[illegible] countries are paying attention to the Japanese [illegible] high technological standards in the area of production [illegible] demonstrated by the strong international competitive power [illegible] and its business administration and industrial vitality [illegible]. In the future, therefore, the age will require Japan [illegible] technological innovations through the full utilization [illegible] standards, industrial vitality, and ample researchers. Consequently [illegible] thoroughly examine the "directions of R&D" discussed [illegible] R&D investment on a long-term basis, [illegible] particular, and promote R&D aimed at the establishment of [illegible].

[illegible] Cooperation Among Industries, Academia, and [illegible]

[illegible] mentioned, Japan's R&D will be promoted principally [illegible]. However, since technologies will become more sophisticated, complex, [illegible] in the future, it is extremely important for Japan to [illegible], academic, and industrial R&D. For this reason, [illegible] for the private sector to systematically cooperate [illegible] and universities so as to effectively promote R&D. [illegible] and the government's support [illegible] system are as follows.

[illegible]

[illegible] important role in [illegible] research as well [illegible] private sector. In [illegible] to the overall upgrading of Japan's [illegible] creative research [illegible] in the future as well, since [illegible] the research expenditure per researcher [illegible]; therefore an improvement in [illegible].

[illegible]

[illegible] . Alternatively, [illegible] industrial and liberalizing [illegible] .

[illegible]

[illegible] the government, namely, [illegible] the private sector [illegible] will become [illegible] to facilitate basic [illegible] industries, [illegible] domestic and foreign [illegible] that the role of [illegible] .

[illegible] the policies [illegible]

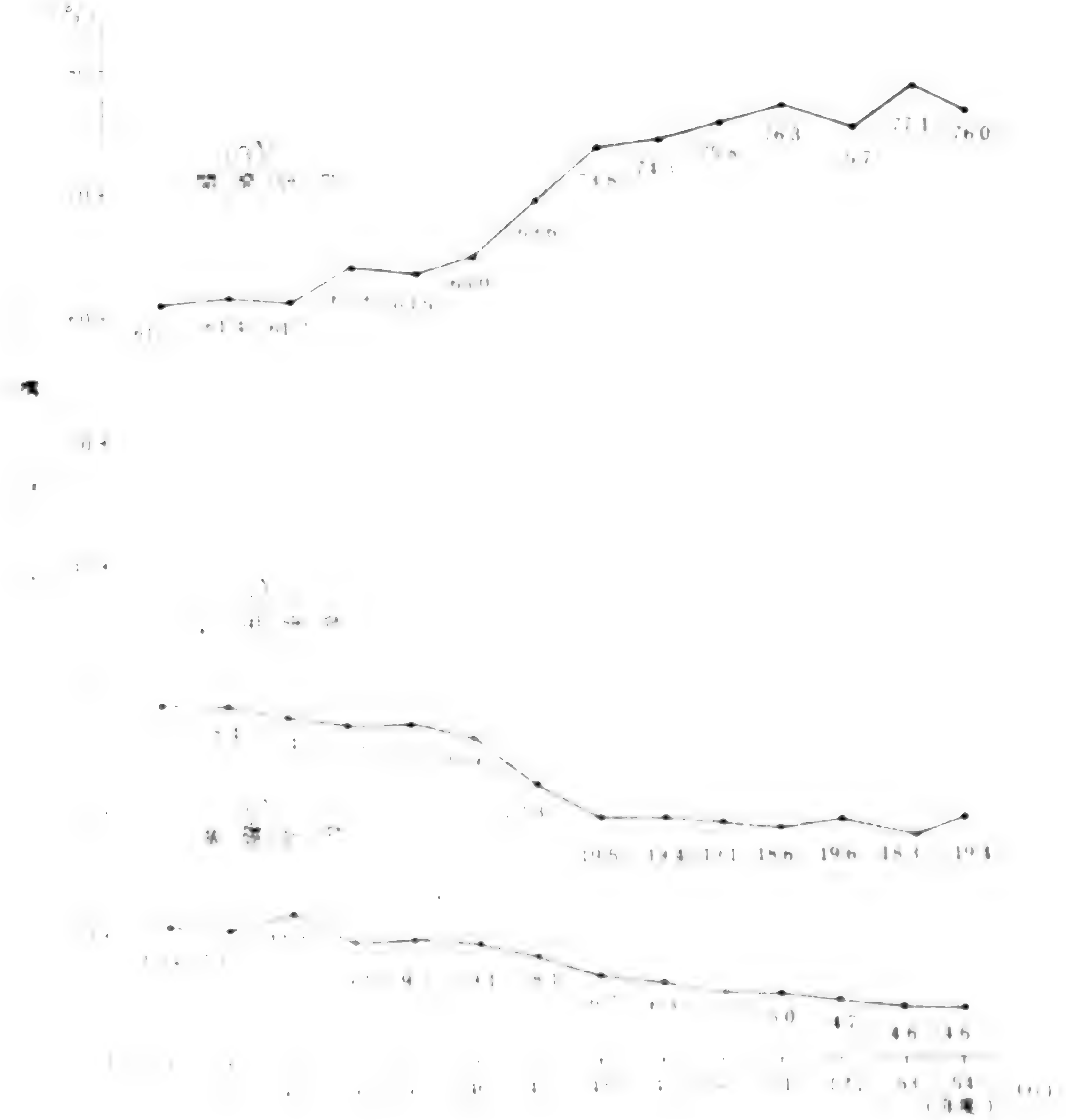
[illegible] indus- [illegible]

[illegible] , favor- [illegible] the private sector.

[illegible] private sector, it [illegible] the West, [illegible] industrial indus- [illegible] investment [illegible] and competition [illegible] government [illegible] therefore, [illegible]

[illegible]

[illegible] 我が国の企業研究費の段階別内訳推移



[illegible]

（1）表1－3 主要国における産業別研究費と政府負担割合

(3) 国 (1) 産業部門	(2) [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(11) [illegible]	100(274)	100(311)	100(517)	100(527)	10[illegible](411)	100(44[illegible])
(12) 1 [illegible]	【269】	【367】	【350】	【471】	【[illegible]】	（　）
(13) 政府	131(129)	153(153)	266(241)	228(215)	152(146)	2[illegible](2[illegible])
(14) 企業	195(130)	147(100)	84(54)	155(151)	162(157)	1[illegible](139)
(15) 非営利団体	22(03)	32(22)	24(18)	14(0[illegible])	02(02)	
(16) [illegible]	552(12)	664(236)	627(194)	603(152)	584(108)	5[illegible]([illegible])
(17) 2 [illegible]の研究費 [illegible]分野別内訳						
(18) [illegible]	（　）	158(123)	1[illegible](112)	112(70)	49(28)	（　）
(19) [illegible]	128(00)	9[illegible](08)	112(04)	11[illegible]([illegible])	184([illegible])	124([illegible])
電子・電気	155(01)	133(60)	148(66)	167(38)	1[illegible]([illegible])	194(1[illegible])
[illegible]	111(08)	76(11)	49(04)	71([illegible])	44([illegible]2)	56([illegible])
[illegible]	34(01)	20(02)	22(00)	2[illegible]([illegible])	19(0[illegible])	[illegible]
[illegible]	71(01)	120(16)	45(04)	30(02)	[illegible](10)	43([illegible])
[illegible]	16(00)	23(05)	41(01)	34([illegible])	1[illegible]([illegible])	16([illegible])
[illegible]	41(00)	22(01)	17(00)	1[illegible](01)	[illegible](01)	16
[illegible]	58([illegible]1)	21(10)	57(03)	4[illegible]([illegible])	40([illegible])	[illegible]
[illegible]	[illegible]2(0[illegible])	[illegible]	98(0[illegible])	[illegible]	16([illegible])	

[illegible] 航空機は[illegible]に含まれる。

[illegible]（　）内は政府研究費[illegible]政府負担[illegible]

[illegible]（　）[illegible]

[illegible]

[illegible] countries' research expenditure — Industries and
[illegible] Government

[illegible]

[illegible] government funding, [illegible]

[illegible]

[illegible] expenditure [illegible] country

[illegible]

[illegible] countries' research expenditure [illegible] industries

[illegible]

[illegible] manufacturing industries

[illegible]
[illegible] the government except
[illegible]

[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

[illegible]	[illegible]
[illegible]	This is indispensable for IC and LSI production.
[illegible]	Used for Nippon Telegraph and Telephone (NTT) Corporation's communication circuits and Tsukuba Research Institute' computer circuits.
[illegible]	[illegible]
[illegible]	[illegible] export product for [illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

(Continuation of Table 4-4)

Examples of Achievements	Remarks
Setonaikai environment preservation hydraulic model (Chugoku Government Industrial Research Institute)	The world's largest model for an inland sea hydraulic model which uses [illegible] tons of water.
Oil fence (Chemical Technology Research Institute)	Commercialized by Toyoda Spinning and Weaving Co Ltd
Ultrasonic diagnosis system (Toshiba Corporation)*	Highly effective for early diagnosis of heart and stomach diseases by the usage of ultrasonic waves.
Polymer whisker (Research Institute for Polymers and Textiles)	The world's first plastic whisker. Sony Corporation has used it for their speakers.

Note: * Important technology subsidy

Source: MITI survey

[illegible] case, however, those industries which are based on microtechnology, [illegible] technology, and compound technology should pay special attention [illegible] the Western countries are likewise expecting these industries [illegible] the motivating power for developing their economies. For [illegible], it is desirable to emphasize joint international R&D such as [illegible] carried out by the aircraft industry. In addition, in the case [illegible] -oriented industry, too, we must consider technology transfer, [illegible] and technological cooperation with the countries with resources, [illegible] developing countries. As international R&D develops, [illegible] the Japanese government will become more significant than ever.

[illegible] cooperation between national experiment and research agencies and the private sector has established a considerable record in the past. The Research [illegible] of the Agency of Industrial Science and Technology, in particular, [illegible] contributed to the activation of the private sector's R&D [illegible] transfer of its research achievements and technological [illegible] necessary that experiment and research agencies promote [illegible] achievements for full use by the private sector in the future [illegible], and at the same time engage in joint research and technological [illegible] the private sector [illegible].

[illegible] industrial property [illegible] essential in [illegible] consolidating the system [illegible] introducing a [illegible] applications, etc.

[illegible] effort to fully [illegible]

[illegible] and complex, it [illegible] society, and culture [illegible] nature of techno[illegible] For example, in the [illegible] ever.

[illegible]

[illegible] and the Large Scale [illegible]

[illegible] Areas which have a greater impact on [illegible] society, industry [illegible] in the long run but require a long period before commerciali- [illegible].

[illegible] Areas which need to establish a cooperative system among [illegible] in order to integrate essential technologies from various areas and require [illegible] large amount of development investment.

[illegible] Areas which the economic society [illegible] greater need [illegible] require urgent attention for development.

[illegible] Areas which are based on public needs and [illegible] social systems.

[illegible] national experiment and research agencies will [illegible] which was conducted by the government. [illegible] of Industrial Science and Technology [illegible] initiative in R&D through developing advanced [illegible] and resources related technologies, promoting [illegible] international cooperation with [illegible] and production technology of the [illegible] experiment and research agencies are strongly [illegible] which will evaluate the novelty, [illegible] diversified and sophisticated materials and [illegible] in the future.

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